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THE MIMETIC ORIGIN AND DEVELOPMENT OF BIRD LANGUAGE.

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WHATELY, Archbishop of Dublin, remarked a half-century since,—"man is not the only animal that can make use of language to express what is passing in his mind and can understand, more or less, what is so expressed by another;" a remark which echoes with the increasing emphasis of another fifty years, the pious poet's couplet—

> "I shall not ask Jean Jacques Rousseau
> Whether birds confabulate or no."

Darwin thinks "the sounds uttered by birds offer in several respects the nearest analogy to language: for all the members of the same species utter the same instinctive cries expressive of their emotions, and all the kinds that have the power of singing, exert this power instinctively, but the actual song is learned from their parents or foster-parents."

The longer this subject is critically considered, the more are we convinced that the communication of ideas by means of sound and gesture (language) is instinctive and common to all animals;—that it is a genetically transmitted faculty, quite independent, in its earliest manifestations, of experiential or empiric knowledge, and that laws, governing the development of

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any one language, have an equal application to all the rest. It is quite generally conceded that the present status of human language is the result of slow developement or evolution from the innate, inarticulate and exclamatory utterances of our human progenitors.

We see apt illustration of this in the gesticulations and cries of the newly born of man, bird or beast; which cries, originating in the primal idea of want, are its natural, spontaneous expression, and, in consonance with the other faculties, develop through early life to maturity, furnishing, in the momentary individual life, a brief, actual epitome of the genesis of language through successive generations in the infinite past. Therefore in so far as he may have "no knowledge but a cry" man may account himself not only a little lower than the angels, but quite as low as the creatures over whom he has dominion. Thus far language is an instinct common to all, and, in nature, identical among all animals; a conclusion necessitating in us the sort of humility which nowadays leavens all progressive inquiry.

Of language, in its original and primitive exercise, such a view is tenable, but in its wider acceptation, as Horne Tooke remarks,—"language is an art, the developement of which is consonant with that of the mental faculties," and it is reasonable to infer that while articulate language (speech) is peculiar to man, distinctly separating him, as Cuvier states, from other animals, "it is not the mere power of articulation that distinguishes man from the other animals, for as every one knows, parrots can talk, but it is his larger power of connecting definite sounds with definite ideas."[1]

It follows therefore, that the language of birds differs not in kind from that of man, though far removed therefrom in degree of perfection as an art. Allowing for the difference in mental capacity, betwixt man and the lower animals, the comparative attainments among men in the linguistic art exhibit disparities no greater than may daily be observed of birds *inter se.* As the singing of a thrush to the chatter of sparrows, so the solo

[1] Descent of Man. Vol. I., P. 53.

of a Patti to the hurly-burly of an Italian marketplace; or (extending parallels to tribal characters) if we compare the Fuegian or Caffiric tongues with those of more enlightened races, the contrast, however startling, finds its equivalent in a comparison between oscine and non-oscine orders of birds.

Between the higher and lower oscines there exists the same gradation of vocal attainments as exhibited by the dialects of nations speaking a language derived from the same parent tongue, and Bechstein, pushing the analogy further, instances how slight geographic differences of song among members of the same species inhabiting widely separated districts, may be appositely compared to "provincial dialects" among speaking peoples.

The inference of Darwin, "that an instinctive tendency to acquire an art is not a peculiarity confined to man" receives daily confirmation in the life history of all the creatures. It is apparent not only in the language of birds, but also in the construction of their nests and in their methods of discovering and storing food.

The ratiocinative processes which distinguish artificial from natural or innate actions are unmistakably apparent in the musical performances of our higher oscine birds.

Among the North American Turdidæ are several species which habitually retire to more secluded portions of their forest haunt to rehearse, in critical undertone, difficult bars and passages of the favorite song, and it is demonstrably true that the older and more experienced of these vocalists surpass the younger by reason of their longer practice.

In this respect bird-language has developed into a fine art analogous to the attainment made in bird-architecture, as exampled by the play-houses of the Bower Bird and two American wrens,[1] and in the ornate embellishment of their nests by the Trochilidæ and Vireonidæ.

Barrington, in his paper on the "Songs of Birds"[2] has well remarked that "that there is no better method of investigating

[1] *Troglodytes aedon* & *Cistothorus palustris*.

[2] Trans. Phil. Soc. 1776.

the human faculties than by a comparison with those of (other) animals," and *vice versa* the same will hold in an inquiry like the one now before us. In the evolution of language as in everything else, we may recognize the all-pervading unity of plan and purpose, the "one law, one element and one far-off divine event to which," not man alone, but "the whole creation moves." This granted, the wealth of all past philological research is at our disposal and by so much are we warned of quicksand hypotheses and set upon a theory of some endurance.

Perhaps the theory most generally accepted as accounting for the origin of human language, is the onomatopoetic or mimetic, coupled with that elaborated by Wedgewood,—the interjectional or exclamatory theory. Wedgewood's theory has more to do with the original and instinctive sounds which form the primitive utterances of the speaking animal, while the mimetic accounts for the subsequent development of language into an art. Leaving all discussion of the tenability of these in their application to human language, let us apply them to birds.

The most cursory study of the songs of our feathered favorites must lead every inquirer to believe them the result of imitation, and a more critical examination would demonstrate that not only does this apply to the transmission of song from one generation to another, but it may be held to account for the origin and development of all bird-language in the past.

Consonant with our proposition, we find among the least specialized of avian forms that language is limited to half audible hissing or choking sounds or even to life-long silence,—an attempt merely, with sure-attendant failure. In such, language has been doomed to perpetual infancy; development in this direction has done nothing, has nought to do with it; it is not this noise or that noise, but *a* noise they are trying to make. The primal death-birth of speech is the result. Except as a proof that language, out of the chaos of silence, had a beginning so dumbly weak and abortive, we here have nothing to do with it either. Next come such as have found a tongue; an

unruly, screaming or croaking member, 'tis true, yet a tangible something for us to hear and heed; its products tangible too, for there is some attempt at combination and modulation there for discriminating ears. And so, from Pygopodes ascending, we start with promises, attempt and failure to climb the vocal scale through Longipennes upward. I will classify a few of the better known species illustrating the mimetic development of bird language into three,—1. Mimics of sounds in animate nature exclusive of other bird-notes: 2. Mimics of sounds in inanimate nature: 3. Mimics of song and human language. In the first class are many, probably a majority, whose notes in greater or less degree are intentionally imitative of those of other birds, and, for sake of illustration, are not so significant as those which (unlike the Mocking-bird, Catbird and Carolina Wren etc.) are not intentional, but seemingly unconscious mimics of animate sounds produced in their immediate environment. The Mocking-bird, Catbird, Shrike and Jay are studied and artistic imitators of their feathered associates, indicating the perfection to which bird-language has developed as an art, but if we would seek examples of the primary, instinctive exercise of the mimetic faculty, the notes of the Prairie, Bluewing, and Yellow warbler, the Grasshopper warbler of Europe, the Yellow-wing and Savannah sparrow together with most of those of the Ardeidæ, Anatidæ, Rallidæ and of some of the better known Strigidæ and Falconidæ, afford a better illustration. The resemblance of the notes of many smaller birds to those of insects of contemporary habitat is very noticeable in the songs of the five first mentioned in the above list.

Each of these sings so like a grasshopper haunting its respective locality as to deceive the unpracticed ear, causing the careless observer to overlook them entirely.

Among the lower orders, this ornithic mimicry, owing to the less complicated and exclamatory nature of their language, is more easily studied. To receive forcible proof of this, let the reader adventure on an April evening's tramp along our river marshes. To most, the novelty of such an experience would lend just the necessary stimulus to imagination and when, after

having every sense of musical concord outraged by the vast callithumpian chorus, there should come, as there surely will, an echo of tenfold emphasis from overhead, eliciting now here, now there, the wierd password till all is hushed along the shore, —then, methinks, in sounds not sweet he could detect a direful harmony.

But the Qua bird's is as one among the many voices of the night which nearly concerns us. Of perhaps four species of frog which in the spring make such localities nightly jubilant, two, more especially, are as well "taken off," vocally speaking, by the Bittern and Green heron as they are in the more literal sense of the phrase. To the third it seems fair to assign the origin of all quacking and its corresponding modifications among the Anatidæ, while the fourth makes a sound so like the notes of a Sora Rail as to put one in doubt which is the best mimic. Turning over the pages of Nuttall's "Ornithology" at this moment, the following, relating to the morning cries of the yellow-breasted Rail seems opportune. "As soon as awake, they call out in an abrupt and cackling cry, 'kreck, 'krek, 'krek, 'krek, 'kuk 'k'kh, which note, apparently from the young was answered by the parent in a lower, soothing tone. The whole of these uncouth and gutteral notes have no bad resemblance to the croaking of the tree-frog, as to sound."

To the student of shadows of things gone by, nocturnal sounds and scenes are a fitting environment. How to-day's dark guess gathers increasing light by this backward look into the infinite night of myriad yesterdays, where lie, in silent readiness, the unspoken but not unspeakable secrets of the past!

In considering the second class of bird-mimics,—viz., those which imitate sounds in inanimate nature, we approach nearer the question of the origin as distinguished from that of the development of their language. Aristotle goes to the root of the matter when he queries regarding the European Bittern's note, —"why do those which are called Bomugi, and which are fabulously reported to be bulls consecrated to some deity, usually dwell among marshes which are situate near rivers? Is

not such a sound produced when rivers inundate marshes or marshes overflow their boundaries and are either roughly checked in their impetuous course by the sea and thence send forth a rushing sound? Similar sounds are produced in caverns underground into which currents of water rush and dispel the air through small apertures."[1] According to both the Mosiac and Darwinian genesis we are to believe that this elemental turmoil and river rushing was a primal thing and precedent of reptilian life just as reptilian life preceded avian life; therefore the whole family "Bomugi" may have had their music second-hand, through batrachian ante-cessors, from wind and wave and chafed shore. If this be true of Bomugus, it is true of all, however shrouded now by the intricate processes of their evolution from such crude, unmusical beginnings to the higher minstrelsy of the present.

At risk of the imputation of having a too fertile imagination, I will separate the second class of sound mimics into two divisions,—viz: 1. Mimics of water sounds; 2. Mimics of wind sounds. The long and short-billed Marsh Wrens and the Winter Wren sing songs so in harmony with their aquatic surroundings that you must be attentive to separate them from the rippling, bubbling sounds of moving water which they affect, the songs of the former being as characteristic of a marsh-receding tide as the other is in its unison with the prattle of woodland rivulets. The same may be observed of the Dipper, Kingfisher, Aquatic Thrush, Blue-yellow-back Warbler, Seaside Finch, Swamp Sparrow and others of like predilections. Many years ago, when the subject began to claim my attention, I call to mind having nearly decided that the Swallows all sang improvisations of a single theme, the rapid clattering of their own mandibles. But on a later occasion, it having struck my fancy that I detected in the joyous little flight-song of a White-bellied Swallow coursing near by, a likeness to the dripping sound of water, I waited till its repetition and then asked my companion, a wide awake negro boy, if he heard "that bird"? "Why," said he, "was that a bird? I thought it was

[1] Aristotle, Problem II., 35.

rainin'." A showery April day had sufficed to complete the illusion.

For a long while, too, the shrieks and hootings of sundry owls continually suggested an unnameable likeness to other sounds in nature, but save that impossible original in the north window casements, none other presented itself to mind.

Then in hypothetic despair I bethought me of an empty porter bottle which once hoo-hooed and shrieked, to the wind responsive, from a nigh fence panel, till a wrathful storm made end of it.

With twofold thanks that the bottle was empty, I now am wont to picture how, ages ago, the mute, inarticulate Scops sat taking music lessons in his porter-bottle house, and how in piny solitudes remote, great Bubo tuned those bass-viol monotones of his in full accord.

The mourning Dove is typical of a family whose voices are in symphonious keeping, with the sighing cedars and moaning pines of their choice. The same correspondence is noticeable in species which, like the Grouse, Vulture, Swan and other aquatic kinds are mute or nearly silent.

In contrast with the silent Vulture, content with silent victims, the nearly related Eagles and Hawks are a screaming, noisy set of birds which seem to have adopted for their own a quintessence of the dying utterances of their victims merely because of carnal policy and from no delight in language in itself considered.

However, the further consideration of this, more properly belongs to the last division of mimics, *i.e.* those which intentionally imitate the sounds produced by their contemporaries.

It were best, ere passing on, to allude to a few others of those birds whose notes resemble the sounds produced by the action of wind. The Broad-wing Hawk's love-notes are like the sound of high-whistling winds or the shrill creaking of interfering tree limbs, or may be imagined by another to be the exaggerated shrieking of a stricken hare or field-mouse. Possibly, yes, probably, all of these may have had combined influence.

The same previously noted of Doves, may apply to the "pewee" of the Flycatcher, the "yank yank" of Nuthatches, the scolding of our Vireos, parts of the song of many higher oscines, (Turdidæ and Icteridæ), and all songs of the more essentially whistling birds, or at least, such part of it as they have not acquired from the whistling Batrachia. Whistling, and its fife-like modulations was likely among the smaller thick-billed families, to be the natural outcome of the imitative faculty, limited in quality and variety by the peculiar structure of their mandibles, but the appearance of tenuiostral forms enabled the more specialized vocalists to produce those more flexible, flute-like songs, which characterize them.

The third class division of mimics will include birds unmistakably imitators of their contemporaries in song,—mockers in the strict sense, and indebted to furred and feathered originals for the greater part. All in this class have a score of their own, a thread of original prose melody, lavishly embellished by poetic quotations from their favorite authors. By way of distinguishing these from the rest let us compare the Mocking-bird and Song-Sparrow. Each are songsters *par excellence* in their separate classes; each boast of a varied repertory, yet in the last, these variations are merely varietal combinations of the "sui, sibi, se or sésé" solus of ancestral Melospiza, and (*inter se*) differ only by numerical sequence of the syllables in a "four foot iambic," or by a change of accent or the addition of a final syllable, convert iambus to trochee and wind up with anapest flourish; whereas Mimus, multiplying his own wild originality by a hundred borrowed roots endlessly declines and conjugates, or with Pentecostal inspiration speaks all languages in one. From "yon trim Shakspeare on the tree," we pass again by exquisite minor gradations of the feathered genius, to sweet sparrow-rhymes and rhymesters many. Past Brown Thrush, Cat-Bird and White-eyed Vireo, by whom a sort of five minute rule has been set up in which each borrowed phrase is given impartial hearing, according to calendar, as if it were; —so on, by way of the Baltimore Oriole, Carolina Wren and others, which are not chronically mockers, but hold that talent

in heroic reserve for after-dinner speeches, we reach the notes of such as quickened the highly sensitive ear of a Nuttall or Burroughs by some vague likeness in them to other note of bird or beast,—chance utterances remotely suggestive of a first attempt at exercising the latent talent for mimicry.

But so nearly do these nice discrimations bring us to the mysterious borderland where fact and fiction intermingle, it were well to pause and confess our fallibility.

In his "Birds in the Bush," Mr. Torrey aptly remarks of a turn or grace-note, in the song of *Dendroeca virens*, which he was tempted to number among "the latest" of philological discoveries, that "perhaps after the lapse of ten-thousand years, more or less, the whole tribe of Black throated Greens will have adopted it, and then when some ornithologist chances to fall in with an old-fashioned specimen who still clings to the plain song as we commonly hear it, he will fancy that to be the very latest modern improvement and proceed forwith to enlighten the scientific world with a description of the novelty."

Beyond what has been said of this native genius in feathers, I may not in present limits so enlarge as to notice that interesting subject, the influence of domestication and human training upon the language of birds, save to note that every experiment made with a view to solve the problem of its origin and development justifies the belief that bird language, as now existent, is, like human language, "the result of some operation of the imitative principle, quickened in all probability by circumstances which we are able to a certain extent to reconstruct, and aided at first very largely, but always in lessening measure, by the language of sign and gesture. [1]

The joke of Prof. Schleicher, "If a pig were ever to say to me, 'I am a pig,' it would, *ipso facto*, cease to be a pig," while controverting the ultra Darwinian theory by its reference to the impassable language barrier, twixt man and the rest of the animal kingdom, nevertheless assumes a serious and questionable significance if the names of certain birds were substituted for the pigs.' Independently of the question of man's descent,

[1] See Philology; Appleton's Ency., New Ed.

however, the result of Darwin's life-long study of psychical and physical evolution receives wonderful confirmation in the family resemblance of notes peculiar to species whose genealogies, according to the development hypothesis, are tracable to the same ancestry. The Icteridæ form a group, the genera of which emphatically demonstrates this.

In the song of the Bobolink, a well known representative, he who runs may read a sure word of prophecy, proclaiming to the ear in its every emphasis, the same scientific facts as does his anatomy to the eye.

Who, that hears him say, in lusty May-song, "I'm a finch, I'm a finch, Icterus, Icterus, Quiscalus, Molothrus, Sturnella, one and all; as you'll see if you look at me, chee! Agelæus et cetera, all linked in me, a bobolink, bobolink, as you can see!"—dare contradict a word of it on biological grounds?

Not less confirmatory of this and of the theory of the mimitic origin of bird notes is the evidence given by species of widely separted generic characters which frequent the same sort of habitat and are subject during life to the same environing influences.

Some of these, as the Robin, Scarlet Tanager, Rose-breast Grosbeak and Baltimore Oriole, have song-notes in common, while the Woodcock, Night-Hawk and Snipe, have nearly the same squeaking call-note when associated together at night as frequently happens, thus indicating that their inspiration was derived from like natural sources, and that, in harmony with their limited vocal needs, it has remained content with squeaking. But, strange to relate, the members of this same trio have each made an attempt at something higher, and, (which is stranger than all) with nearly identical results. In the Goatsucker it is a hollow, booming sound, produced by its sudden downward descent during flight; in the Snipe and Woodcock it results from a whirring of wings during a slowly ascending and descending spiral flight. Such is the commonly accepted belief of observers of these manœuvres, and, if correct, they illustrate how, in the retarded organic development of any faculty, nature supplements it by mechanical ingenuity.

May we not in conclusion, fittingly adopt the words of a modern seer, with him agreeing that "between two opposing tendencies, one urging to variation, the other to permanence, (for nature herself is half radical, half conservative) the language of birds has grown from rude beginnings to its present beautiful diversity, and whoever lives a century of milleniums hence, will listen to music such as we in this day can only dream of. Inappreciably but ceaselessly the work goes on. Here and there is born a master singer, a feathered genius, and every generation makes it own addition to the glorious inheritance!"

A MONTH IN THE EASTERN PHILLIPINES.

BY J. B. STEERE.

WE spent the last days of March, 1888, at Cebu, in packing our collections from the Central islands. We were fortunate in finding an American vessel in port, sailing to Boston, and nearly loaded with sugar and manila hemp, and shipped home several cases of bird skins and other valuable and perishable collections by her, while the bulkier part, corals and sea shells, were left to be forwarded in the same way at a later date. We then took passage on the little Spanish steamer "Gravina," for Catbalogan on the island of Samar, the most eastern of the archipelago. The weather was of the ordinary Philippine kind, calm and with smooth seas. We left Cebu about noon, passed by the northern end of Bojol, and were then in sight of the mountains of Leite, and we spent the evening in coasting up the west shore of that island. The next morning when we waked up we were lying at anchor in front of the town of Catbalogan. We were started out of our berths a little sooner than common by an outcry among the Spanish passengers, and a call for the "Naturalistas Americanos." Hurrying into one of the passage ways, I found a Spanish military officer

standing in a tragic attitude, with his sword thrust through a poor little centipede, which he had pinned to the floor.

The harbor of Catbalogan is formed by several small islands but is not considered safe in storms from the northwest. The town is on low ground near the sea, and has about ten thousand inhabitants, and shows the usual church and parish house with a governor'sand other officer's residences, for it is the capital of a province ; in addition to the usual streets of Indian houses supported on posts in the ordinary way. The town had an unmistakable appearance of age and unthrift, though the little square in front of the church was decorated with triumphal arches and flowers, for we had brought a new governor with us, the same who had so courageously attacked the centipede in the morning.

The island of Samar is some one hundred and twenty miles long, by thirty or forty broad, and is said to have two hundred thousand inhabitants. Its native name is *Ibabao*, which means *up above*, and we were certain before we had left it that it was well named. It is very mountainous and steep so that a great part of it is uncultivable. The exports are chiefly of manila hemp which is sent to Cebu or Manila for shipment.

The captain of the steamer landed us and our goods on the beach and steamed away, and we were left again to find a home among strangers. There was no hotel, as is usual in such towns, and the people were too busy with the new governor to care for us, and it looked for some time as if we might go hungry and without shelter unless we took refuge in the *tribunal*, the court-house, jail and common assembly room of the Indian population, but after noon we found an empty house and making a bargain with the owner, and hiring a young Indian for cook, we moved in that night. Our house was out on the borders of the town near the hills. It had a room large enough to hold our hammocks, and another back one open on all sides, serving for a kitchen, dining-room and a place in which to skin birds. The hills covered with second growth were just behind us and we could see unmistakable patches of virgin forest on the mountain sides, two or three miles far-

ther back and we concluded to make the place our headquarters for the month we had devoted to this part of the island. The next morning I dressed and started to the governor's residence, to present our passports and other papers, but the rest of the party, anxious to see what could be found in this new field, were in the hills before my arrival, and the reports of their heavy guns were rolling down upon the town as if it was besieged. A squad of Indian soldiers were hurried out after them, and made out to capture one of the party, and march him in, just after I had shown our papers, when he was released without ceremony.

The birds, in the jungle of second growth near town, were, many of them, the same we had found in other parts of the group, but the first day's hunt proved that we had reached a new and distinct location.

A number of birds, including the large Philippine crow, the yellow oriole, the black, and bald headed starlings, the white collared kingfisher, one or two sun birds, the fruit-thrushes, and the little scarlet breasted parrots, and many others, are such common residents about the Indian towns, and especially in the coco groves, and are so rarely found in the virgin forest, that we learned to expect them everywhere we went. Their distribution may have depended in part upon the habit the natives have of capturing these birds and carrying them from place to place. Since the islands have been inhabited there can be no doubt that man has been the chief agent of distribution, and of much greater importance than storms, floating timber, etc., all taken together.

We had,at a step, passed from the region where the dry season was at its height in Negros, Cebu, and Bojol, to where the rainy season was beginning. The mountains behind were much of the time enveloped in dark mists and thunder clouds and one or two showers had already reached down to the town. The steep hills between us and the true forest were wet and slippery, and we found our best means of reaching the hunting grounds was to employ native boatmen to pilot us up the little tidal river in their canoes to the foot of the mountains. The

authorities seem to have become discouraged in trying to make roads in such a country, and though a bridge had been built over the river, the road after running along the beach for two miles, had been abandoned, and all the commerce of the place is carried in boats and on men's backs. The mountains were heavily timbered and very steep. Several mountain streams formed the river, these flowing along narrow ravines, running for some distance over flat-ledges of rock and then breaking over perpendicular precipices in waterfalls into deep pools below. We found the beds of these shallow streams our best paths, and adopting the native *alpargate*, a canvas sandal with hemp sole, we spent our time in following their beds, shooting from the overhanging trees, and the mountain sides above. It was still dry at the town, though it rained nearly every day in the mountains, but usually in the afternoon, and everything was dripping with moisture. We seemed to be in the rain clouds themselves. The land leeches were swarming and very troublesome, even making their way through the meshes of our stockings. But with all our discouragements we were rapidly adding species new to our collection, and new to science. Among these were a new squirrel, a new broad-bill of the genus *Sarcophanops*, first described from Basilian, two new woodpeckers, and another fruit-thrush, and a little crow, these two latter staying in the mountains and not interfering with their relatives about the town below. A great horn-bill proved to be distinct from its allies in Mindanao and Luzon.

A division of the party took a native boat, and pushed down to the south into the strait of San Juanico, between Samar and Leite, and stopped for ten days at the village of Babatgnon, on the latter island. The fauna appeared to be identical with that from Samar as might be expected, the strait being in many places not over a mile or two in width and this frequently narrowed by small islands.

Toward the latter part of our stay, the rains came farther and farther down the mountain side, and storms became frequent at the town itself, and so continuous in the mountains as to hinder us considerably in our work. Reptiles were abund-

ant, crocodiles were found in the river we used as a highway, and our Indian boatmen would devoutly cross themselves and say their prayers before wading into the deeper places. Nearly every day we started the large plant-eating lizard, called *ibit*, from the bushes on the sides of the river, and they frequently made directly across the stream in front of us, not swimming in the water, but moving rapidly over the surface, apparently chiefly by strokes of the broad flattened tail and of the hind feet, the head and fore part of the body being elevated high in the air. This is much nearer the position of birds in swimming than that of most reptiles. Perhaps some of the fossil reptilia moved in this way. We encountered two or three cobra de capellos in our hunting. One of them, an immense fellow, lay coiled behind a big rock with its head raised and neck flattened in the traditional style. The *Naturalista Americano*, was within fair biting distance of him as he turned the corner of the rock, and was so frightened that he allowed the snake to drop down and glide out of sight. He did not do much collecting the rest of that day, but spent most of his time in looking out for snakes. There is no doubt but that the cobra, hearing the noise, was looking out for food, but finding the game too big to swallow, got out of the way without striking. One of the under officers at Catbalogan had a large python which he had kept for a number of years in a cage. The snake was about fifteen feet long, and as thick as a man's thigh. He was fed once a month, and his appetite demanded a good sized dog at a meal. As the time for his dinner arrived, he became active, gliding about the cage with head raised and when the trap door was lifted and the dog dropped in it was seized before it touched the bottom, and a coil being thrown about it, it was crushed to death before it had time to howl. After his meal the snake lay for weeks in so deep a sleep that I could not waken him by punching him with my cane. One could run over such a snake in the jungle and hardly know it. A large number of deaths undoubtedly occur in the Philippines from poisonous serpents and pythons, but from the apathy of the people but little attention is paid to it. If a person is killed in this way it is his *suerte* or fortune, just

as it is of the gains or loses on a cock fight. Remedies for snake poison abound as in other countries. One old Indian who had been to Manila and had dabbled in drugs, assured us that if he could reach the person bitten before he was quite dead he could save him by applying muriatic acid. The flying lizard, *Draco*, found here differed from those we had collected in other parts, in its larger size, and in having the under surface of the membranes bright red in color.

At the end of the month devoted to Samar and Leite, we found a little brig, built in the Philippines, and commanded by a Spaniard, loaded with manila hemp and bound for Manila. Making a bargain with the captain to land us on the island of Masbate, which lay very close to his route, we hurriedly gathered our collections and luggage together, and embarked.

ON THE DEVELOPMENT OF CALIFORNIA FOOD FISHES.

C. H. EIGENMANN.

FROM a biological standpoint the Surf Perches are the most interesting of the California fishes. The species inhabiting the shores of California are probably all well known, and the later stages of their larval development have been well treated by Agassiz, Blake and Ryder. Dr. Charles Girard was able to examine younger stages than the other writers, but he did not contribute much to our knowledge of them. Until now the ripe eggs and embryos of these fishes have not been seen. During the past two months, December and January, I have been enabled to examine many individuals of almost all the species found in San Diego Bay. In most of them I have found embryos or ripe eggs. *Micrometrus aggregatus*, on account of its abundance, the ease with which it can be caught, and the fact that different individuals of the same date have young in widely different stages of development, has proved to be the

most interesting of the species. An account of it will serve for all the others. As is well known, the egg-bearing lamellæ are broad sheets which are suspended from the roof of the ovary; there are usually three of these sheets in each half of the ovary. The eggs are very small (.2 mm.) as compared with the eggs of other fishes: they protrude from the lamellæ much as other fish ova do and they seem to be surrounded by a more transparent area. I have seen the eggs of several species but for lack of proper facilities to study the material collected a more detailed description cannot be given at present. The eggs of *Micrometrus aggregatus* have the yolk collected in spherical masses, and there seems to be no oil globule, while the eggs of *Ditrema jacksoni* have from one to three oil globules. Whether the eggs are fertilized before they are freed from the lamellæ, I cannot state at present; long before hatching, the eggs are found lying in the folds of the ovary. The eye is much less conspicuous than in other fish embryos, and the hypertrophied hind gut is developed before hatching. In larvæ in which the mouth was apparently not yet formed, the vent was open and the vigorous peristaltic action which was confined to the hind gut began at the vent and traveled forward; this would seem to make it probable that food is taken in through the vent in the earliest stages of the larval existence. A structure whose significance has not yet been determined is found in larvæ less than half an inch long. It consists of a spirally twisted, opaque white substance lying free in the hind gut; it terminates posteriorly in a knob; its anterior connection has not been traced. During the peristaltic movement mentioned, this spiral moves freely, and in several instances it was entirely withdrawn from the hind gut, the knob at its posterior extremity seeming to form a partial plug at the anterior end of the posterior intestine.

The first indications of the peculiar prolongations of the vertical fins was noticed in larvæ an inch long; all the fins were well developed and the interradial membranes projected as short, broad flaps beyond the tips of the rays.

The Herring, *Clupea mirabilis*, enters the bay of San Diego

in great numbers during December and January. The eggs are very adhesive when first deposited, but half an hour after deposition they lose their stickiness and remain free when loosened. The yolk is collected in spherical masses. The protoplasm is yellow, and the formation of the germinal disk can readily be watched. Strands of the protoplasm can be seen extending from it into the yolk. The first cleavage furrow is formed about two hours after fertilization, and the first cleavage occupies about forty-five minutes. The furrow travels slowly towards the base of the germinal disk, which it reaches in about twenty-eight minutes; at this stage the two newly formed cells seem well separated. As soon as the furrow has reached the base of the disk it begins to retreat, leaving but a line to separate the two cells. When the furrow has entirely retreated, the division of the two cells is not very plain, and the second furrow is immediately formed. The division of the disk into four cells is more rapid than its division into two. The further development very much resembles that of the shad as it is described by Ryder; it is, however, much slower. The blastopore closes about thirty hours after segmentation. The heart is formed near the close of the second day. Kupfer's vesicle appears about fifty hours after fertilization. On the sixth day one shell was found, but the escaped fish could not be seen. Other embroyos continued to be active in the shell five days longer, when they died.

The Smelt of California, *Atherinopsis californiensis*, is one of the most abundant of the food fishes. It enters San Diego bay in December to spawn. The eggs are large and transparent, and, during the earlier stages of development the oil is distributed in a number of globules, while in a later stage but a single oil globule is present. Each egg is provided with about ten long filaments which differ somewhat from those of Fundulus. The base of each filament is enlarged, disk-shaped and apparently hollow, and the substance of the zona seems to enter it. The filaments are uniformly distributed over the surface of the egg, and in the ovary they are coiled around the egg in one direction only.

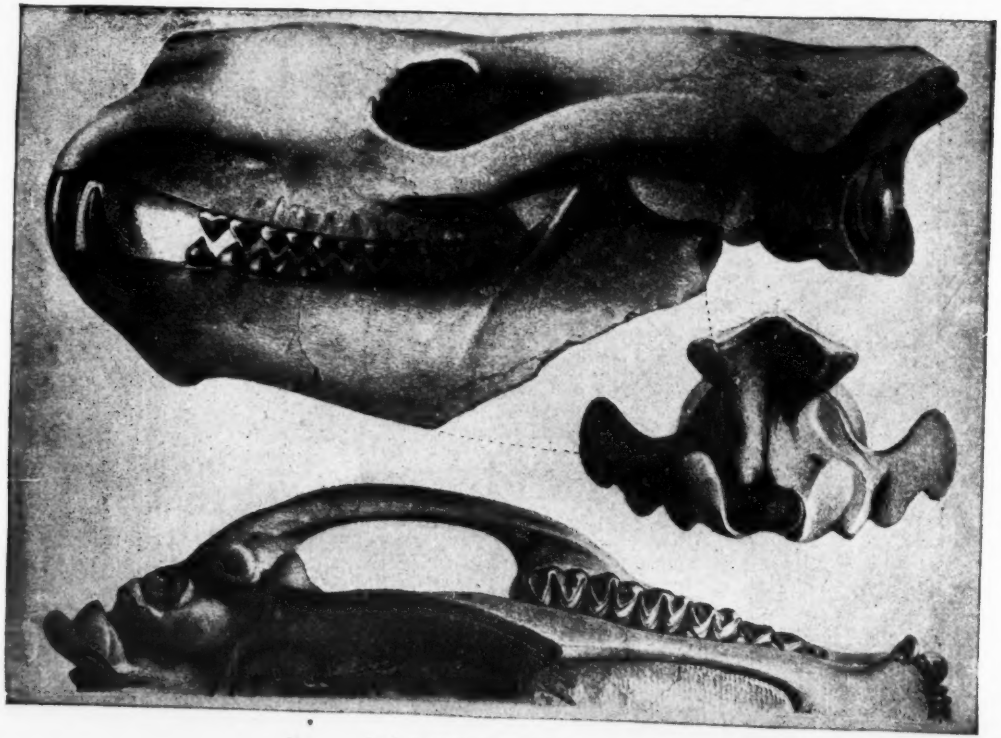
The eggs were artificially fertilized; after three hours twenty-five minutes, the first cleavage was completed. Twenty minutes afterwards four cells had been formed. The time of the development of the other phases may be best tabulated:

16 cells	4 h. 45 min.	after fertilization.
32 cells	5 h. 10 min.	" "
First horizontal furrow	6 h.	" "
Beginning of blastula stage	28 h.	" "

At this stage the free nuclei are very abundant and cover about half the yolk. They are much larger and more numerous just at the edge of the blastula. The blastula stage lasts less than half an hour; the embryonic shield is first seen forty-one hours after fertilization. Two and a half days after fertilization the optic vesicles appear. The blastopore closes after about eighty hours. Kupfer's vesicle and the myotomes appear on the fourth day, the heart on the seventh day; on the twelfth the embryos move vigorously; on the sixteeth day pigment spots appear on the top of the head and along the median line of the back. The water space which at first was inconsiderable has greatly increased. The embroyos were at this time near hatching, but, unfortunately died.

Some larvæ of this species procured afterwards show the following pigment spots: A series along the median line of the back from the occiput to the caudal fold; a spot above the posterior portion of each eye; one medially above the front of the eye; a small one at the nares. A series of spots along the median line of the sides; numerous spots over the air-bladder and upon the abdomen. Later a series is formed along the base of the anal fold. Yellowish dots are found between the black pigment spots of the back and sides. These larvæ have a continuous fin fold from the abdominal region of the back around the tail to the vent; a smaller fold in front of the vent. The embryonic rays are most numerous and best developed at the tail. The caudal shows heterocercal tendencies.

PLATE III.



Agriochoerus guyotianus Cope.

THE ARTIODACTYLA.

BY E. D. COPE.

(Continued from page 1095, Vol. XXII., 1888.)

IN passing from the lower to the higher Artiodactyla we encounter a succession of modifications of the skeleton which give the suborder a higher specialization than any other among mammals. These may be considered under three heads: First, the consolidation of the bones of the carpus and tarsus; second, the development of a tongue and groove of the humero-cubital and metapodio-phalangeal articulations; and third, increased complexity of the intervertebral articulations.

Of consolidation of the bones of the feet we have first, the coössification of the larger two elements of the distal row of the carpus and tarsus; viz.; the trapezoides and magnum in the former, and the meso- and ectocuneiform in the latter. This commences in the Oreodontidæ (Scott) and continues throughout the succeeding families. The next modification of this kind is the coössification of the cuboid bone with the navicular. This commences with the Tragulidæ, and continues throughout the remaining families. The fusion of the metapodials into cannon bones first appears in geological time in the Tragulidae, as does also the fusion of the ulna and radius (in Hypertragulus), and also in the contemporary Poëbrotheriidæ. The reduction in the number of the digits progresses with varying correlation with the other changes, from five in Oreodon to two in Camelus and Bos. As already explained, similar reductions took place in the Eocene members of the suborder, Anoplotherium having the digits 3-3, and Xiphodon 2-2.

The mechanical cause of these coössifications must be regarded as strains incurred in the act of rapid locomotion. Where not sufficient to produce actual flexure, strain is met by resistance and increased nutrition of the tissue, resulting in a strengthening of material at the point of resistance. With such coössifications comes increased mechanical effective-

ness. Kowalevsky has shown that with the reduction of the number of the digits, the metapodials of those which remain, have increased in transverse diameter, so as to articulate with two distal elements of the carpus and tarsus each,

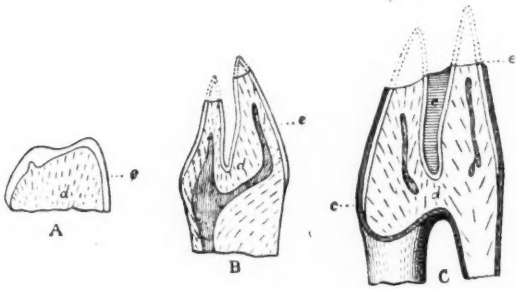


Fig. 7. Transverse sections of molars of Artiodactyla, showing successive complications of structure. A. *Sus crymanthius*; B. *Ovis amaltheus*; C. *Bos taurus*; from Gaudry, Enchainements. Letters: *c*, cementum; *e*, enamel; *d*, dentine.

instead of with but one, as in the primitive types, as Anoplotherium, Hyopotamus and Hippopotamus. (Fig. 8.) He shows that where this expansion of the metapodials did not

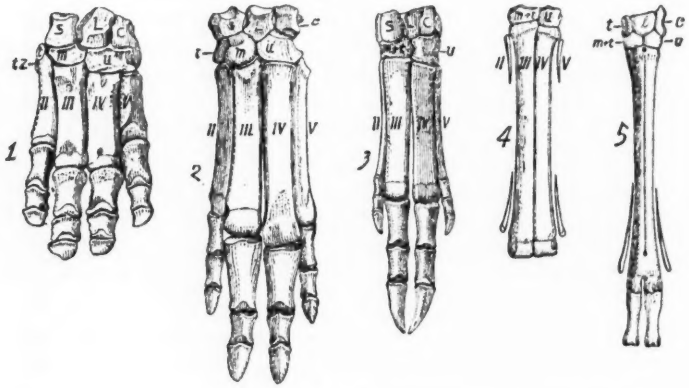


Fig. 8. Fore feet of: 1. Hippopotamus; 2. Hyopotamus; 3. Dorcatherium; 4. Gelocus; 5. Cervus. From Kowalevsky. *S*, scaphoid; *l*, lunar; *c*, cuneiform; *tz*, traperium; *t*, trapezoides; *m*, magnum; *u*, unciform.

take place, the type became extinct, as in Elotherium. He supposes that the extinction of such types was due to the feebleness of the latter construction, which precluded the attainment of any considerable speed on the part of its possessor. The types in which this expansion took place persisted, and became the ancestors of the existing forms. As an example, see Procamelus. (Fig. 10.)

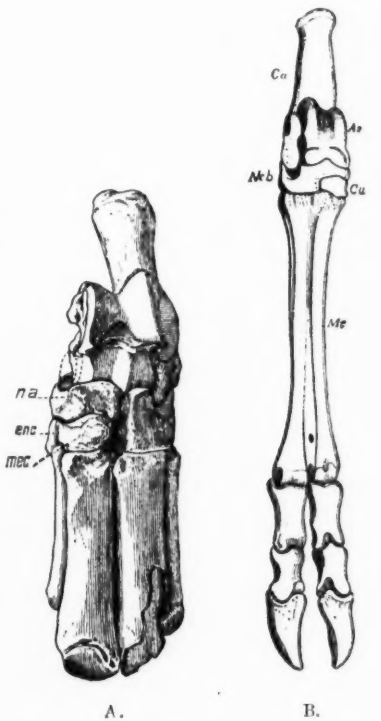


Fig. 9. Pes of Artiodactyla. A. *Merycochoerus montanus* Cope, two-fifths natural size. B. *Bos taurus*. L. one-fourth natural size.

The specialization of the elbow joint first becomes pronounced in the Artiodactyla in the Tragulidae. This consists in the development of the external part of the condyles of the humerus into a roller of contracted diameters, and separated from the remaining part of the condyles by a keel, or tongue. The roller and tongue work into a corresponding plane and groove of the head of the radius, forming an interlocking joint of great strength. The strength of the union between the radius and the ulna is increased by the development of a keel on the inferior side of the head of the former, which fits a groove on the upper side of the latter. Both of these structures can be traced from their beginnings in the Artiodactyla. (Plate V.)

Fig. 10.

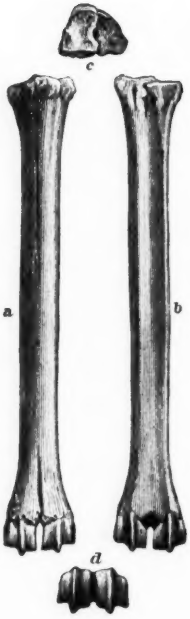


Fig. 11.

Fig. 12.

Fig. 10.—Part of anterior foot of *Procamelus occidentalis* from New Mexico. From Report of of Capt. G. M. Wheeler, Vol. IV, Pt. II.

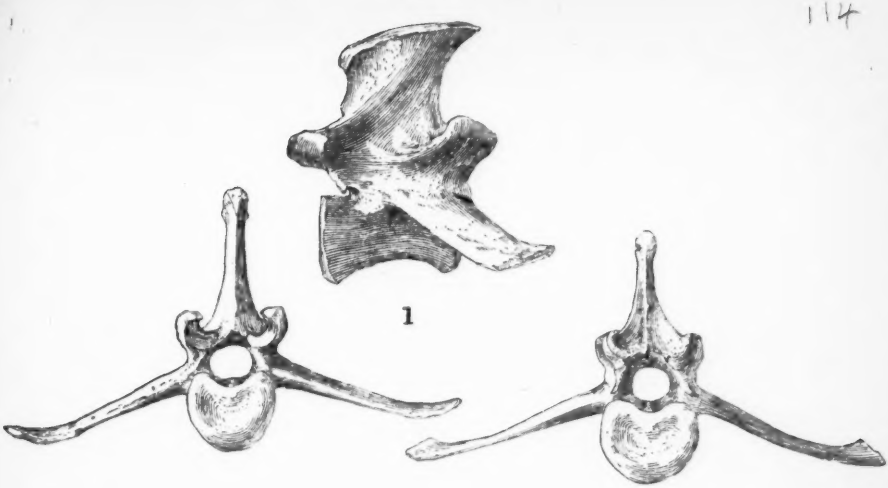
Fig. 11.—Metacarpals of *Cosoryx furcatus* from Nebraska, two thirds natural size; *a*, anterior face; *b*, posterior; *c*, proximal end; *d*, distal end.

Fig. 12.—Left forefoot with part of radius of *Poebrotherium vilsoni* Leidy, from Colorado, three-fifths natural size. From Hayden's report (unpublished).

The trochlear keel or crest,[1] as the tongue of the humerus may be called, is first represented by a convexity of the roller, precisely as in the unguiculate

[1] The trochlear crest of the Artiodactyla is not homologous with the inter-trochlear crest of the Anthropomorpha.

PLATE IV.



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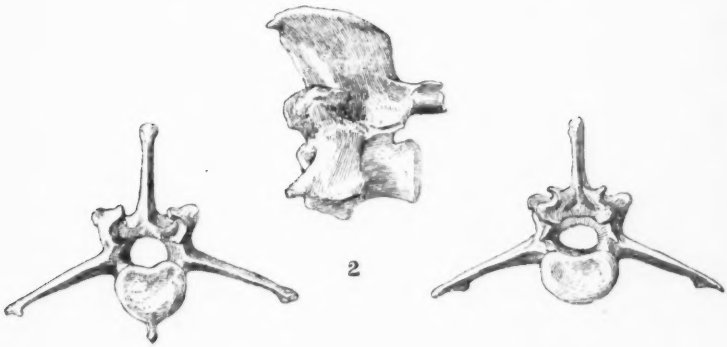

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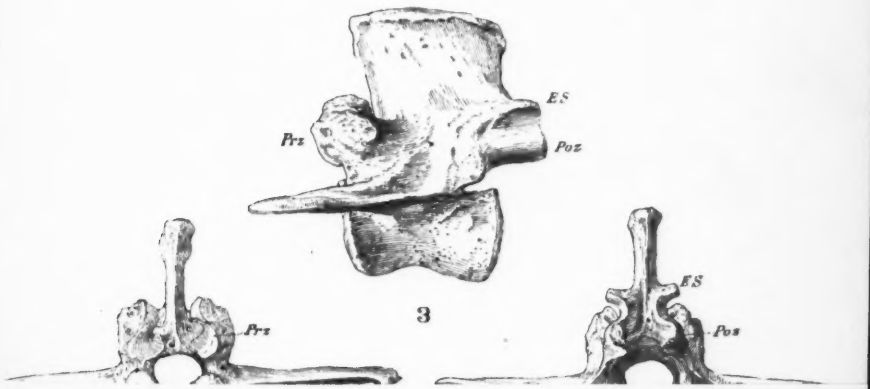


3

mammals. (Plate IV. figs. A, D, Hyæna, Eucrotaphus.) With the compression of the external part of the condyle, the external slope becomes steeper and is at length nearly vertical (Ibid, fig. E, Cervus). The mechanical cause of this trochlear crest is the use of a single fore leg to support the body in rapid locomotion. As had been remarked by H. Allen, a modern Artiodactyle in rapid motion lights on one forefoot, which strikes the earth immediately on or even beyond a point below the middle of the body (fig. 13). This throws the impact principally on the external side of the humeral condyles, with the result stated. A similar cause produces a similiar result in the development of the tongue and groove articulation between the metapodials and first phalanges. In lighting on a didactyle foot, the toes are naturally spread, the result being to throw both the first phalanges away from the median line, or axis of impact, in divergent directions. The result of this impact is to produce on each metapodial condyle as in the case of the humerus, an external roller of smaller diameter than the rest of the condyle (fig. 11), and separated from it by an abrupt crest. In both humerus and metapodial bones these crests are accentuated by a pinching process during flexion and extension. This is produced by the longitudinal torsion which results in all limbs in motion from the arrest of the outward rotation of the foot by the earth, on alighting. The

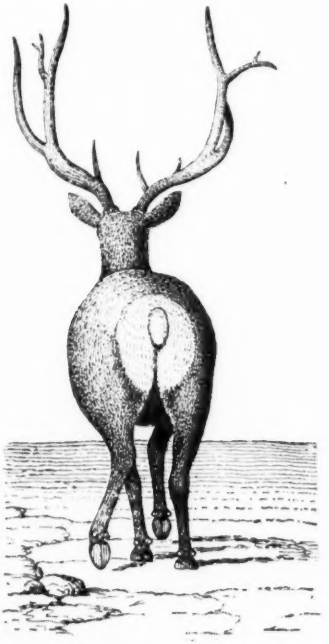


FIG. 13—*Cervus canadensis* in motion, from behind. From the Muybridge photographs.

pinching of a keel by its groove takes place at all points in the length of the former reached by the opposite sides of the extremities of the latter during flexion and extension (fig. 14). This keel becomes acute and prominent in the Boöidea, and extends to the anterior face of the condyle fig. 11, *Cosoryx furcatus*). This development has been apparently especially due to the presence of two sesamoid bones, embedded in the flexor tendons, one on each side of the middle line of the posterior side of the metapodial condyle. The fissure between these bones has permitted the moulding of the surface into a keel to fit it. That this has been the case is further indicated by the fact that a single median trochlear surface exists at the distal extremity of the first phalange in all mammals. But a single flexor tendon crosses

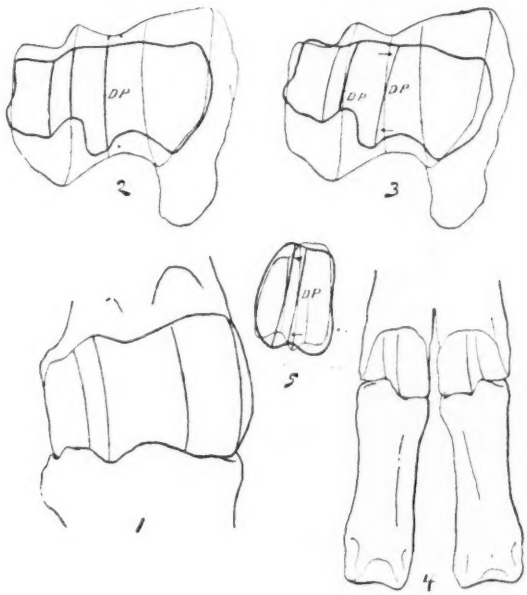


FIG. 14—Tongue and groove joints in *Cervus elaphus*. 1–3, elbow joint with trochlear keel and groove. 1–2, in place; 3, radius dislocated by external torsion. 4–5, metatarso-phalangeal articulation; 4, in place; 5, dislocated by torsion of phalange; *D P*, the dead or fixed point.

this articulation, and it contains but one sesamoid bone, to which the trochlear surface is moulded in a concave surface, as in the case of the patella and the rotular groove of the femur (figs. 8, 9B, 9, 10, 14).

The increased complexity of the intervertebral articulations,[1] is seen in the modifications in the shapes of the zygapophyses.[2] In reptiles the mutual articulating surfaces of these processes are horizontal and flat. In the lower Mammalia they are slightly oblique. In many Carnivora the obliquity is strongly marked, and a similar form is seen in the lower

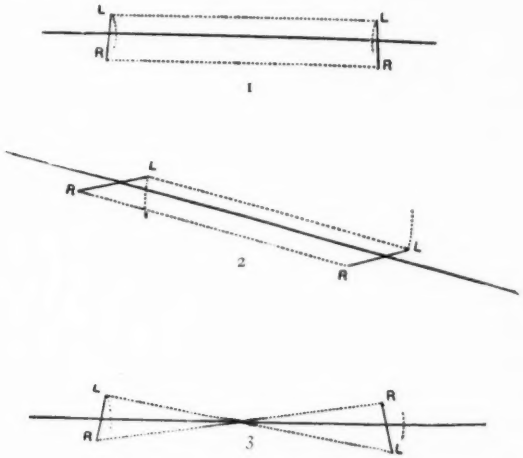


FIG. 15—Diagrams representing movements of the vertebral column in locomotion. 1. The pace; 2. the run; 3. the trot.

Diplarthra. As we ascend the scale of the latter, the prezygapophyses become involute and embrace the postzygapophyses above, as well as externally below (Plate IV., fig. 1, Antilocapra). This superior part of the prezygapophyses develops, and reaches the basis of the neural spine, with which it forms an articulation. The base of the spine expands

[1] For a tabular exhibit of these, see Proceedings Amer. Ass. Adv. Science, 1883; Origin of the Fittest, 1885.

[2] On torsion in locomotion. See art. Perissodactyla, NATURALIST, 1888, 988, 1073.

above this articulation, forming a second process above the postzygapophysis, the episphen. This occurs in the Suoidea and the Boöidea (Plate IV., figs. 2 and 3, Dicotyles and Capra).

The mechanical explanation of the origin of this structure is probably found in the nature of the movement of that part of the vertebral column which is between the limbs during progression; and especially of the more flexible region (lumbar) which is posterior to the ribs. All the gaits of quadrupeds may be reduced to three types, and their varieties. In the first, the extremities of the column are alternately elevated and depressed, without lateral motion. This is seen in the run. In the second, the sides of the column are alternately elevated and depressed. This is seen when the limbs of one side move simultaneously, as in the pace. In the third type, limbs of opposite sides of opposite extremities, move together, as in the walk and trot. The effect of this movement is to twist the column in its long axis. These effects are diagrammatically represented in the accompanying figure 15. It is this torsion which has produced the involuted zygapophyses, and later the episphen. It should be the fact that animals which display this structure should walk and trot, while others should pace and run. And this is the case. The trot as a habitual gait is especially characteristic of the Diplarthra. The Proboscidia and Carnivora pace, although the dogs frequently trot as well. We must suppose that the trot was the favorite gait of the Creodonta, since they possess the involuted zygapophyses.

The only genus certainly referable to the DICHODONTIDÆ, is the Dichodon Owen, from the upper Eocene of England. In this form we have the earliest quadriselenodont molars, the intermediate fifth crescent having disappeared The first superior premolar is like a true molar, while the first inferior is trilobate (Kowalevsky; molariform, Owen). The other premolars are very elongate and compressed, resembling those of Xiphodon. This resemblance is heightened by the incisiform shape of the canines, and the uninterrupted dental series. In the same beds occur limb and foot bones which probably belong to Dichodon (Schlosser) which are didactyle, but in

which the fusion of the trapezoides and magnum in the tarsus, has not yet taken place. The metapodials then rest on a single carpal or tarsal bone each, instead of on two, as in modern didactyle genera, representing the inadaptive type of Kowalevsky. *Dichodon cuspidatus* is about the size of a fallow-deer. Smaller species have been found in Germany. The genus is probably represented in North America by Stibarus Cope, of the White River bed. I have associated provisionally with the Dichodontidæ two North American genera, Agriochoerus Leidy (Plate III.), and Coloreodon Cope (fig. 5). These genera differ from Dichodon in having the first premolars in both jaws molariform or nearly so, and in having the other ones much less compressed, except the fourth inferior, which is caniniform, as in Oreodon. There are four premolars and little or no diastema in Agriochoerus, and three premolars and a long diastema in Coloredon. The former possesses six species, which are equally divided between the White River and John Day beds, and the latter, two species from the John Day Miocene. Their feet are unknown.

The remaining families of the Cameloidea are the Poëbrotheriidæ, Protolabididæ, Camelidæ and Eschatiidæ. I have already described their characters in the pages of the NATURALIST.[1] I will only add to that account the interesting discovery made by Profs. Scott and Osborn, of a third genus of Poëbrotheriidae which they call Leptotragulus. It differs from Poëbrotherium and Gomphotherium, in the separate condition of the ulna and radius.[2] It is from the highest Eocene beds of Utah (Brown's Park, or Uinta system), and thus stands in ancestral relation to Poëbrotherium.

The Cameloid phylum presents a noteworthy peculiarity. The Poëbrotheriidæ have acute trihedral ungual phalanges like those of most other Artiodactyla. In the Camelidæ, including the extinct genus Procamelus, the ungual phalanges are short and obtuse, and apparently undergoing atrophy. This form is associated with the presence of a cushion of connective tissue on the inferior side of the phalanges, which

[1] 1886, p. 611: The Phylogeny of the Camelidæ.

[2] My knowledge of this genus is entirely derived from the unpublished mss. of Profs. Scott and Osborn.

supports the weight of the animal, thus removing it from the ungues. This cushion has relieved the metapodials from impacts and torsion, a fact which I have regarded as explaining the absence of the trochlear keel from the extremity and front of those elements in the Camelidæ. We must then suppose that the development of the elastic foot-pad of the camels began in the Miocene period before this character appears, and caused a divergence from the Booid line in the foot structure. This divergence probably took place before the development of the third stomach, and the addition of water compartments in the paunch may be supposed to have commenced at about the same time.

Existing Camelidæ pace, yet they have more or less distinct epispheneal processes to the vertebræ. These are distinctly visible in Procamelus. We must suppose that their ancestors, as the Poëbrotheriidæ, were trotters, and that the habit has been changed in later periods.

With the TRAGULIDÆ we commence the great, mostly modern division of the Boöidea, or Ruminantia. As already related, most of the characteristic peculiarities of the specialized Artiodactyla commence with this family. The trochlear cylinder and crest of the humerus appear here for the first time, for the Suoid and Cameloid series never develop more than traces of either. The naviculocuboid bone is characteristic. How variable the conditions of the other bones of the limbs are in the Tragulidæ may be gathered from the accompanying table. A few species of two genera, Dorcatherium and Tragulus, still exist in the warm parts of Africa and Asia. These agree with the Camelidæ in the absence of the third stomach, the other three being present.

I. Both metatarsals and metacarpals distinct; molars brachyodont (Hypertragulinæ).

a. Lateral toes behind.

Anterior internal cresent of inferior molars represented by a conical cusp. ..... *Lophiomeryx* Pom.

Interior cresents of inferior molars developed ..... *Dorcatherium* Kaup.

aa. No lateral toes behind.

Diastemata in both iaws ..... *Hypertragulus* Cope.

II. Metatarsals forming a cannon bone; metacarpals distinct; molars brachyodont (Gelocinæ).

a. Lateral digits of the manus, none of the pes.

Superior premolars with a small internal tubercle.....*Leptomeryx* Leidy.

aa. No lateral digits.

Four lower premolars.....*Gelocus* Aym.

Three lower premolars.....*Bachitherium* Filhol.

III. A metatarsal cannon bone; metacarpals forming a cannon bone; molars brachyodont (Tragulinæ).

a. Lateral digits well developed.

Premolars entirely simple.....*Tragulus* Briss.

aa. Lateral digits weak.

Four inferior premolars, the posterior with branch ridges; superior premolar 3 with strong cingulum.....*Amphitragulus* Pomel.

Three inferior premolars, the posterior with branch ridges; superior premolar 3 with strong cingulum, elongate.....*Prodremotherium* Filhol.

IV. Metatarsals and metacarpals unknown; molars hypsodont (Hypisodontinæ).

A diastema behind p. m. 2: canines below not distinct from incisors.

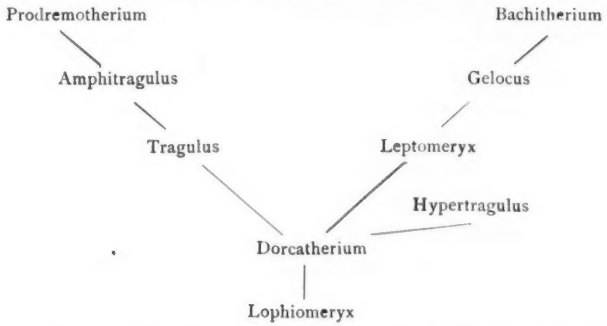
.....*Hypisodus* Cope.

Dorcatherium, an existing genus, has four well developed digits, and is nearest the Oreodontidæ. The only difference between that family and the present one being the presence and absence of the naviculocuboid bone respectively, Dorcatherium must be placed on the Traguloid side of the line. Probably extinct genera will be found which will connect this genus more intimately with the Oreodontidæ, for the slight complication of the premolars of extinct genera of the latter, testify to earlier members with simpler ones.

Lophiomeryx and Hypertragulus must be associated with Dorcatherium on account of the lack of cannon bone. Lophiomeryx has an inferior type of inferior true molar, and like Dorcatherium has four toes on all the feet. Hypertragulus displays greater specialization in the absence of lateral digits from the posterior feet. The ulna is also coössified with the radius, and there is a naviculocuboid bone. The premolar teeth are nevertheless very simple, and are separated by diastemata in both jaws. It must be regarded as a modified descendant of Dorcatherium on one side of the main line of descent. (Plate VI.)

In the next group the metatarsals have united while the metacarpals remain separate. This is the case in Leptomeryx of the American Oligocene. In Tragulus the premolars are much simpler than those of the other genera of Section III,

and simpler than those of Leptomeryx, so that these two forms must have been derived from an ancestor which combined the simplicity of both forms. For this we must again recur to Dorcatherium, and I therefore insert this genus at the base of the following diagram. With its entirely prismatic molars Hypisodus has one element of superiority, but the number of its superior premolars is unknown.

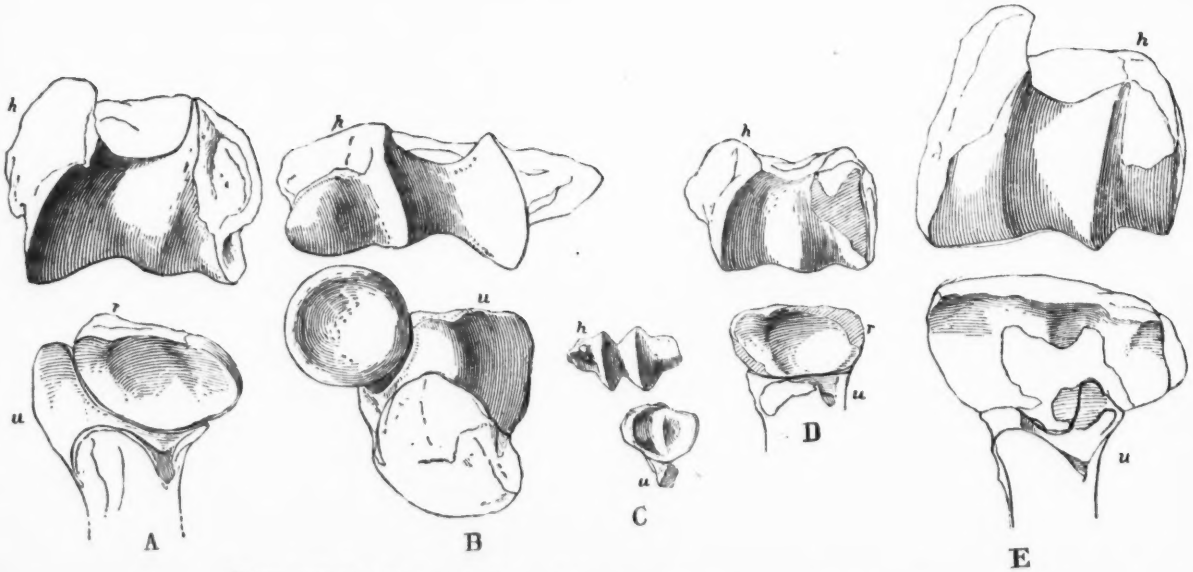


Two species of this family are very abundant in the Cænozoic beds of North America. These are the *Leptomeryx evansi* Leidy of the White River series, and the *Hypertragulus calcaratus* Cope of the same, and of the John Day Miocene series. Either species was of the size of a spaniel, and had delicately formed limbs. The *H. calcaratus* had large eyes, and a compressed muzzle. Larger species are found in Canadian beds. The least species of the family belongs also to the White River Beds. This is the *Hypisodus minimus* Cope, whose size does not exceed that of a gray-squirrel. Like the Leptomeryx, it does not extend upwards into the John Day beds.

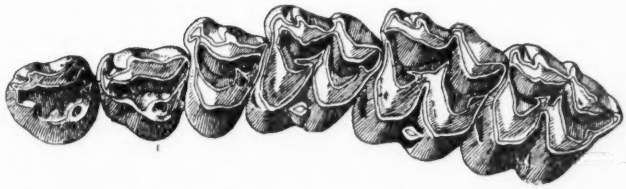
The remaining families of the Boöidea agree in possessing the following characters.

The second and generally the third superior premolar teeth possess an internal crest as well as the fourth fig. 16). The inferior premolar teeth have oblique transverse crests. The keel of the distal extremity of the metapodial bones extends to the front of the condyle (fig. 11). The lateral metapodials are represented by their extremities only, the middle

PLATE V.



Elbow joints of A, Hyæna; B, Simia; C, Rhinolophus; D, Eucrotaphus; E, Cervus.



(FIG. 16.) *Blastomeryx borealis*, Cope, superior molars natural size. From Ticholeptus bed of Montana. Original.

portion having disappeared (fig. 8–5). The median pair are united into a cannon bone. There are no superior incisors. The odontoid process of the axis vertebra is trough-shaped. The stomach is divided into four parts.

The lowest family of the series is that of the Moschidæ. In its hard parts it differs from the Bovidæ in the simplicity of the anterior third superior premolar, which is without the internal crescent found in the other Boöidea. In this respect it is intermediate between that division and the Cameloidea, where the first premolar only possesses the internal crescent. But two genera of Moschidæ are known, Dremotherium from the Lower Miocene of France, and the living Moschus. Both lack horns and have well developed canine teeth. The origin of this group is clearly from the Tragulidæ, and the genus of that family which approaches nearest to it is Amphitragulus, which indeed only differs from it in dentition in the imperfection of the internal crest of the second superior premolar. In turn, Dremotherium must be regarded as ancestral to Palæomeryx, the most primitive genus of the Bovidæ.

The Giraffidæ differ (see table of families) in the mode of attachment of the horns. These are originally separate from the skull, but become attached to it like the epiphyses on the extremities of the bones of the skeleton. Their dental characters are like those of the Cervidæ and the lower Bovidæ, the molars being short crowned or brachyodont. It may be that the condition of the horns in Giraffa represents the mode of origin of the horns of the Bovidæ,[1] and that the genus is simply to be reckoned a primitive type in that family. The

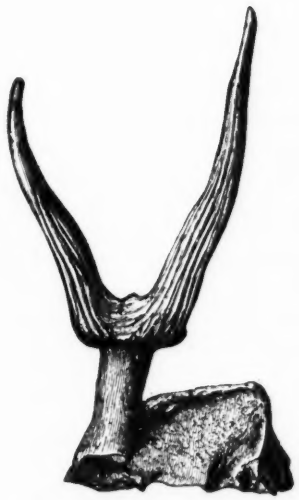
[1] In the sheep the horns begin as bodies separate from the skull.

specialization of the long neck and fore legs would not exclude it from that family. It is merely an adaptation for the habit of browsing on the foliage of tall trees. In the extinct species of its single genus, Giraffa, these characters are found in a less degree than in the existing one, forming transitions to the ordinary forms of Boöidea.

The most obvious distinction between the Bovidæ and the Cervidæ is in the differing character of the bony processes of the skull, used for offense and defense. But where horns are wanting, as is the case with some genera, these distinctions fall to the ground. The horn-type of the Bovidæ is more primitive than that of the Cervidæ, since the horny process is permanent in the former, and is shed and reproduced annually in the latter. The dental type is, however, never so specialized in the deer as is the case with the highest genera of Bovidæ, remaining always distinctly rooted, while in Bos and some other genera of the latter they become prismatic. But the lower genera of Bovidæ do not differ from Cervidæ in this respect.

In accordance with these facts the bovine ruminants appear a little before the cervine, though authors generally refer the earliest genera to the latter division. Such are the genera Dicrocerus and Cosoryx,[1] which appear in the latest Miocene beds. Dicrocerus only differs from Palæomeryx in the possession of horns, which resemble those of deer, but which were, according to Schlosser, never shed, a fact which compels its location in the Bovidæ. In Cosoryx the horns have the same character in this respect, but the teeth are antelopine, or prismatic. It is clearly to be placed in the Bovidæ with Antilocapra (the prong horn,) and it is closely allied to Dicrocerus. Here we see that the point of origin of the two families was from a common ancestor, and that this ancestor was, as has been already expressed by Schlosser, the genus Palæomeryx. Nearly related to this point of departure are the Sivatherium, Bramatherium, and Hydaspidotherium. As they did not shed their horns, they cannot be referred to the Cervidæ. In their covering with the integument, Cosoryx probably possessed a character of Giraffa, which is a primitive

[1] Leidy, Cope ; Procervulus Gaudry.



(FIG. 17.) *Dicrocerus furcatus*, posterior part of skull, one-fourth natural size. Miocene, France. From Gaudry.

stage of the essential character of the horns of the Bovidæ. Perhaps the retention of the primitive dermal character of this investment, instead of its metamorphosis into horn, might be regarded as a basis for a distinct family, the Cosorycidæ. But it is highly improbable that this covering remained in Sivatherium and Bramatherium, whose horns were apparently perfectly naked. It is not evident how all these animals can be retained as distinct from the Bovidæ, and I therefore place them in two subfamilies of that family. The Cosorycinæ, which will include Cosoryx and Blastomeryx, are characterized by the sheath of the horns being dermal; the Sivatheriinæ by the absence of any sheath whatever. The synopsis of genera will then be as follows:

I. No horns in the male.

Molars brachyodont ..... *Palæomeryx*[1] Von Meyer.

II. Horns covered with skin (Cosorycinæ).

Teeth brachyodont; no frontal excrescence ..... *Blastomeryx* Cope.

Teeth prismatic; no frontal excrescence ..... *Cosoryx* Leidy.

III. Horns naked (Sivatheriinæ).

Teeth brachyodont; two pairs of horns, all separate ..... *Sivatherium* Cautl. Falc.

Teeth brachyodont; two pairs of horns; those of the anterior pair from a common base ..... *Bramatherium* Cautl. Falc.

Teeth brachyodont; one pair of horns, from distinct bases ..... *Dicrocerus* Lart.

IV. Horns covered with a horny sheath; teeth hypsodont (Bovinæ).

a. No internal column of true molars.

β. No lateral ungues. (Nasal bones normal; postzygapophyses single).

Horn-sheath furcate ..... *Antilocapra* Ord.

Horn-sheath simple ..... *Nanotragus* Sund.

[1] Should *P. eminens*, type of Palæomeryx, have possessed horns, as suspected by Schlosser, the generic name must take the place of Dicrocerus below, and be replaced by one of the various names which apply to hornless species.

$\beta\beta$. Lateral ungues present.

γ. Nasal bones separated from maxillary and lachrymal bones.

Horns simple, one pair ..... *Saiga* Gray.

$\gamma\gamma$. Nasal bones more or less in contact with lachrymal or maxillary bones.

δ. Lumbar postzygapophyses single. (Numerous species not examined)

ε. Inferior premolars three.

Horns one pair ..... *Antidorcas* Gray.

$\varepsilon\varepsilon$. Inferior premolars four.

Horns two pair ..... *Tetracerus* H. Smith.

Horns one pair; last inferior molar with four columns ..... *Neotragus*[1] Gray.

Horns one pair; last inferior molar with five columns ..... *Ovis*[2] H. Smith.

$\delta\delta$. Lumbar postzygapophyses double.

Horns one pair; inf. mol. 3 with five columns ..... *Capra* Linn.

aa. One or more superior true molars with a median internal column.

Lumbar postzygapophyses single ..... *Ægocerus* H. Sm.

Lumbar postzygapophyses double ..... *Bos*.[4] Linn.

A great number of names have been given to groups of species of the Bovinæ, especially within the limits of the genus Ovis of H. Smith. Here the various forms of sheep and antelopes have been distinguished as genera, and named accordingly. So far as concerns the skeleton, further subdivisions than those indicated in the above table do not appear to exist, and none have been pointed out. The divisions proposed appear to be rather those of one extensive genus. The modifications of the skull have reference to the position of the horns. These are processes of the frontal bones, and are placed at points from above the eye to the posterior angle of the facial plane of the skull. In the latter case this angle approaches very near to the supraoccipital crest or inion, and the parietal bone is reduced to an exceedingly narrow band between the frontal and occipital bones (Rütimeyer).[5] Forms with anterior horns and well developed parietal bones are *Ovis gazella* and *Tetracerus quadricornis*; while the *Ovis gnu*

[1] *N. saltianus* type. This character is derived from authority to which I cannot now refer. I have not seen it.

[2] Includes the following supposed genera: Antilope, Gazella, Cervicapra, Oreotragus, Cephalophus, Strepsicerus, Damalis, Alcelaphus, Nemorrhædus, Rapicapra, Caloblepas, Haplocerus, Ovis, and Anoa.

[3] Includes the following supposed genera: Eleotragus, Ægocerus, Oryx, Addax and Portax.

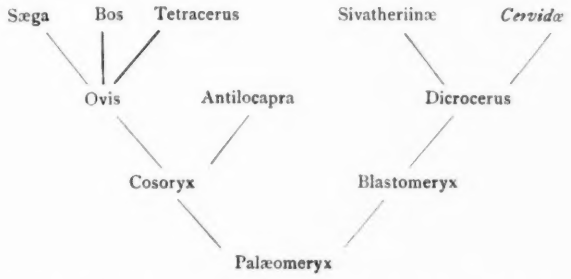
[4] In *Bos americanus* the postzygapophyses are single except on the last lumbar.

[5] Die Rinder der Tertiär-Epoche; Abh. Schweiz. Pal. Gess., v, 1878.

displays the parietal extremely reduced, and become chiefly lateral in position. As regards the forms of the horns themselves, they present no important differences, but are angular and revolute in the section Ovis, and cylindric in the division Antilope. In the latter they vary in direction from straight to spiral or curved in different directions. Within the genus Ovis the end of the muzzle is naked or hairy, the latter in the typical forms and in those inhabiting northern and alpine localities generally. Those species that inhabit grassy or desert plains have the end of the nose naked.

Within the genus Bos modifications are observed parallel to those in the genus Ovis. The frontal bones with the horn processes are produced more and more posteriorly until the parietal bones are reduced to a narrow band across the posterior part of the skull. The bisons have the horns most anterior ; then follow the buffalos, and the extreme is reached in the true oxen, of which the domesticated animal is the type.

The following table will give an idea of the phylogeny of the Bovidæ.



The hornless Palæomeryx has given origin to the horned Boöidea ; on the one hand to the brachyodont (Blastomeryx, etc.), and on the other to the hypsodonts (Cosoryx, etc.). A cornification of the integument in a fork horned Cosoryx produced Antilocapra, while the same process in a simple-horned Cosoryx, produced Ovis. The development of this type has undergone the three principal modifications indicated by the three genera which succeed upwards. In Sæga an extra-

ordinary development of the muzzle takes place, which causes a change in the relations of the nasal bones. In Tetracerus another pair of horns is developed in front of the usual pair. Bos developes complications of the molar teeth in both jaws.

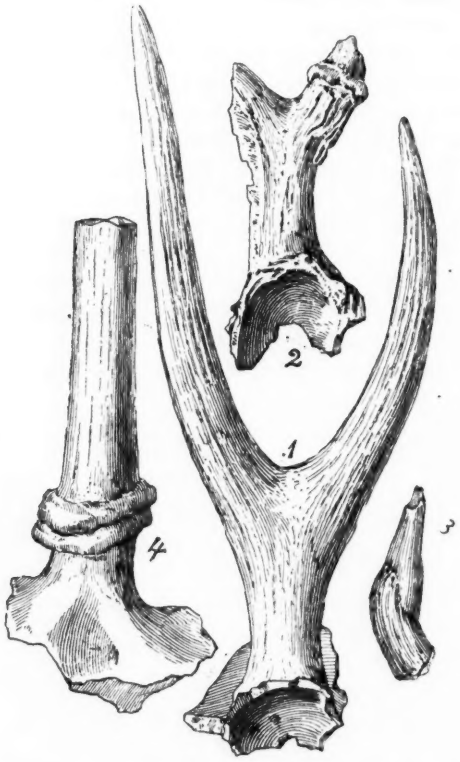


FIG. 18.—Cosoryx horns, three-quarters natural size, showing burrs and repaired fracture. Figs. 1-2, *C. necatus* Leidy. Figs. 3-4, *C ramosus* Cope. From the Loup Fork Miocene of New Mexico. From Report U. S. G. G. Surv. w. of 100 meridian.

On the brachyodont side the development of the dermal covering of the horns of Blastomeryx is arrested, and naked horned types follow. In the Sivatheriine group no further

change follows except complication of the horns. In the Cervine group, on the contrary, the habit of shedding them becomes fixed, and a new family has its origin.

No species certainly referable to Palæomeryx or Dicrocerus have been as yet found in North America, but they may be detected at any time. Numerous species have been found in Europe. Cosoryx is abundant in North America, six species being known (fig. 18, *C. necatus and C. ramosus*). They vary in size from that of a gazelle to that of a

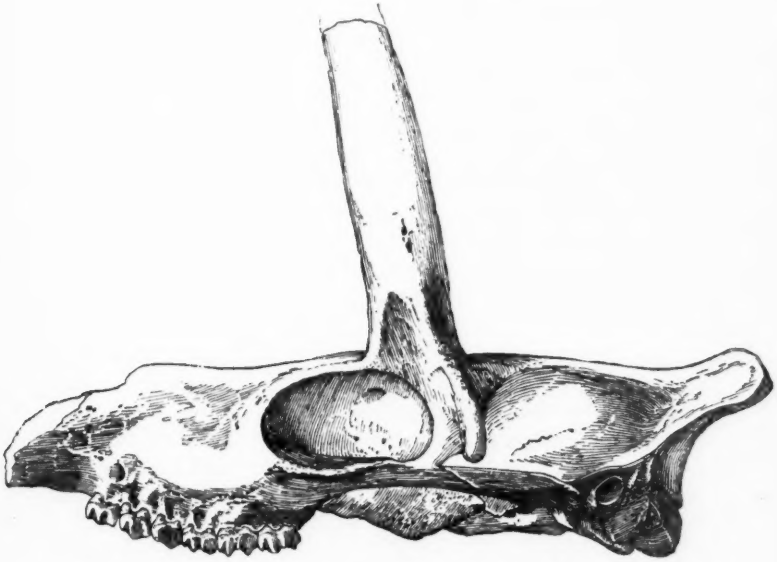


FIG. 19—*Blastomeryx borealis* Cope, one-sixth nat. size. From Ticholeptus bed of Montana; original.

fallow-deer. Although they did not shed their horns, some individuals developed a burr near the base of the beam, and burrs are found on the branches followed by broken down bone (Figs. 18, 2). In other cases broken points of antlers have become reattached, showing the presence of an integument to retain them. I have suggested that the development of the burr was due to the stripping or laceration of this integu-

ment to and at the base of the beam, producing an engorgement of the vessels and deposit of calcic phosphate; and that the stripping of the horns when complete resulted in their death and subsequent sloughing, thus originating the periodical shedding of the horns characteristic of the deer. This periodicity would depend on the periodicity of the season of reproduction, when the horns are especially used in conflicts between the males (Fig. 17).

Two species of Blastomeryx are known, a smaller, and a larger (*B. borealis*, Fig. 19), which was about the size of the Virginia deer. It is common in the beds of the Ticholeptus epoch. At the base of the horn on each side, a wing-like expansion extends outwards posterior to the orbit, giving a peculiar appearance to the anterior view.

The extinct species belonging to the Sivatheriinæ are only known from the upper Cænozoic beds of India, and they are among the most remarkable of the Artiodactyla. Several of them were of gigantic size, and their horns were of curious and formidable shapes. In the *Sivatherium giganteum* Cautl. Falc., the fore legs were longer than the hind legs; the forehead was concave, and furnished with a supraorbital horn on each side. The posterior horns were broadly palmate, and the muzzle is supposed to have been produced and convex above, as in the moose (Fig. 20).

The smaller Bovidæ are called Antelopes. Extinct species are numerous in the upper Cænozoic formations of Europe and Asia, but they are wanting from corresponding beds in North America. The European species are related only subgenerically to those now existing in central and south Africa. All sorts of grada-

FIG. 20—*Sivatherium giganteum* C. F. cranium from front, much reduced. From Falconer. Miocene, India.

PLATE VII.

Bos taurus (from Cuvier.)

tions leading to the true genus Bos are found, especially in India, where many species of large size and various development of horns have been found. It appears that Bos is a polyphyletic genus, the divisions known as Bison, Bubalus and Bos, having arisen from as many types of Antelopes, which resemble them in the positions of the horns. In North America the division Bison only has been found, and this in Plistocene beds. Such are the species *Bos alleni* Marsh, and *B. latifrons* of Harlan. The latter species was of large size, the horn-cores of some specimens being as thick as a man's leg. It is evident that the line of the Boöidea was not continuous in North America, but that its later representatives were derived from the old world.

The following series may approximate a correct representation of the phylogeny of the genus Bos, expressed in genera.

Bos Ovis (sens. lat.) Cosoryx Palæomeryx	Bovidæ.
Dremotherium	Moschidæ.
Amphitragulus Gelocus Leptomeryx Dorcatherium	Tragulidæ.
Anthracotherium Cebochœrus	Anthracotheriidæ.
Pantolestes	Pantolestidæ.

Of the Cervidæ or the Boöidea which shed their horns, the genus Cervus is one of the earliest with which we are acquainted. Undoubted species of the genus occur in the Pliocene, and Upper Miocene species are also referred to it. As species from the Lower Pliocene (*C. matheroni* Gerv.) are referred to Capreolus, those of the Miocene may not be true Cervi. Their structure is not sufficiently known to determine this point. The arrangement of the genera is as follows. The three primary divisions were established by Brooke.

I Lateral metapodials complete only distally, and supporting dewclaws (Telemetcarpi).

a. Nasal passages posteriorly two, separated by vomer (Cariaci).

Horns simple spikes ..... *Coassus* Gray.
Horns more or less furcate ..... *Cariacus* Gray.
Horns palmate ..... *Rangifer* H. Smith.

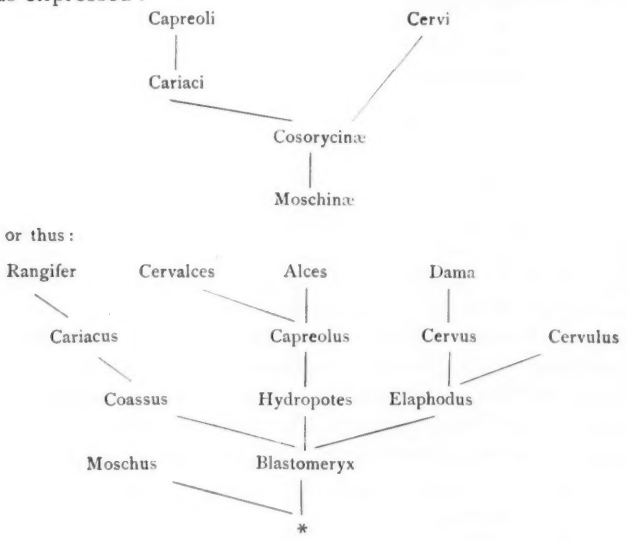
aa. Nasal passage posteriorly one, not divided (Capreoli).

No horns ..... *Hydropotes* Swinh.
Horns furcate; no postantler ..... *Capreolus* Gray.
Horns palmate; no postantler ..... *Alces* H. Smith.
Horns palmate; a postantler ..... *Cervalces* Scott.

II. Lateral metapodials represented by proximal splints only; nasal passage not divided (Plesiometacarpi). (Cervi).

Frontal cutaneous glands; horns furcate ..... *Cervulus* Blv.
No frontal glands; horns simple ..... *Elaphodus* M. Edw
No frontal glands; horns furcate ..... *Cervus* Linn.
No frontal glands; horns palmate ..... *Dama* H. Smith.
Horns furcate; brow antler greatly exceeding beam, (Gill) ... *Elaphurus* M. Edw.

The phylogeny of these genera cannot be fully known until the skeletons of the extinct genera and species have been obtained. It is, however, certain that the short series of genera included in each of the three divisions (II *a* and *aa*, III) are genetic series; and also that division I is ancestral to both II and III, although perhaps by an extinct genus differing in some respects from Moschus. These relations can be thus expressed:



Each of the genetic series commences with a genus with no or with very simple horns. The next genus or stage presents branched horns, sometimes of great complexity. The last term in each is the palmate horn, where a greater or less number of the tines unite to form a plate. These series, as is well known, correspond with the history of the growth of the horns in successive years of the life of each species. (Fig. 21.)

None of the genera of this family are extinct except Cervalces Scott.

The true Cervidæ form a family of very recent origin, and only distinguished at the period when forms like Cosoryx and Dicrocerus began to shed their horns. Dicrocerus is repre-

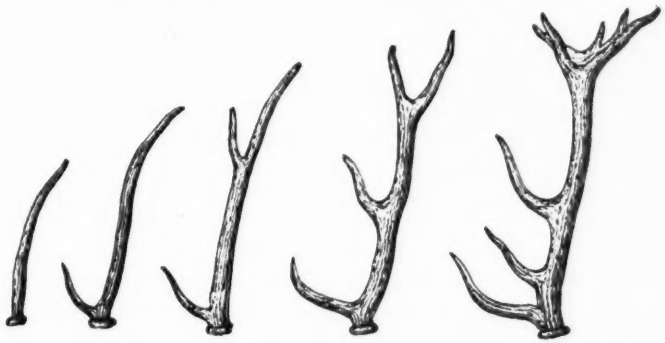


FIG. 21. Horns of *Cervus elaphus* from the second to the sixth years inclusive. From Cuvier.

sented by several species in the middle Miocene of Europe, and their horns are mostly bifurcate as in the third year's horn of a true deer. In the middle Miocene and part of the Pliocene the horns have three antlers as in the fourth year of Cervus, and as is permanent in the genus or section Rusa of tropical Asia.

The many branched horns appear in the Pliocene and Plistocene in Europe, in numerous species. In America extinct Cervidæ are more abundant than Bovidæ. Several species occur in the Pliocene beds of Buenos Ayres, and of Washington. The latter are related to the Moose (*Alces brevitrabalis* Cope) and American deer, (*Cariacus ensifer* Cope.) A very

remarkable species occurs in the Plistocene beds of the eastern region, the *Cervalces americanus* Harlan. Its affinities are with the Moose, with which it agrees nearly in size ; but it differs in possessing a posterior branch to the horn, which forms a broad, curved plate extending outwards above and behind the orbit, which resembles somewhat a hearing trumpet.

ADDENDUM.

In the first part of this article in the NATURALIST for December, 1888, p. 1088, I have given the characters of the subfamily, Dicotylinæ, of the family Hippopotamidæ, and of the two included genera, Dicotyles and Platygonus. Some amendment of these definitions is necessary, as follows: That of the sub-family "Digits three" should be supplemented by the words,—on the anterior foot, and four on the posterior. The genera are both stated to have premolar teeth similar to the true molars. This statement must be qualified as regards the species now referred to Dicotyles, and must be contradicted as regards Platygonus. In the latter genus the deciduous premolars only resemble the true molars (fig. 6, p. 1093), and they have the peculiarity of remaining in the jaw until the last true molar is nearly protruded. In Dicotyles, the deciduous teeth have disappeared before the last true molar is protruded. The permanent premolars are, as Leidy has described them, generally simpler than the true molars, consisting of two external, and one internal tubercle.

But the species differ so much in the characters of their premolars that they can be referred to three subdivisions, which may be at some future time regarded as genera. These are as follows :

I. Premolars all different from molars (*Notophorus* Gray) ; *D. tajassus.*

II. Last premolar only, like the molars (*Dicotyles* Cuv.) ; *D. labiatus* Cuv. ; *D. serus* Cope ; *D. angulatus* Cope.[1]

III. Second premolar (from front) like true molars (*Mylohyus* Cope) ; *D. nasutus* Leidy.

It is uncertain whether the complex premolar of *D. nasutus*

[1] AMERICAN NATURALIST, Feb. 1889.

is the penultimate or the last premolar. If it is the last, the genus Mylohyus will be distinguished by the presence of only two premolars.

An examination of the crania of *Dicotyles tajassus* in the U. S. National Museum from Costa Rica, shows that they display characters intermediate between the Brazilian typical form, and the *D. angulatus* of Texas. The last premolar teeth are sometimes premolariform, and less frequently approach the molariform structure. The facial angle is continued to the position of the canine aveolus, and the ridge of the maxillary bone is only separated from its border by a groove, not a fossa. The nasal bones are not tectiform. In general the characters agree with the *D. tajassus*, but the lateral facial angle is as in *D. angulatus*, and occasionally the last premolar resembles that of the same species. It appears then that the latter must be regarded as a subspecies rather than a species.

EXPLANATION OF PLATES.

PLATE III.

Agriochœr s guyotianus Cope, skull, natural size; from side, and one-half from below. From the John Day Bed of Oregon. Original from unpublished plate in Report of U.S. Geol. Survey Terrs.

PLATE IV.

The elbow joint of Mammalia, separated, and seen from above and posteriorly. A, *Crocuta maculata*. B, *Simia nigra*. C, *Rhinolophus* sp. D, *Eucrotaphus pacificus*. E, *Cervus elaphus*. All four-fifths natural size.

PLATE V.

Vertebræ of Artiodactyla, two-thirds natural size. Fig. 1 *Antilocapra americana;* 2, *Dicotyles angulatus;* 3, *Capra hircus*. *Prz* prezygapoplysis; *Poz* postzygapoplysis; E.S. Episphen.

PLATE VI.

Hypertragulus calcaratus Cope, skull, natural size; from the lower Miocene. Fig. 1, lower jaw from above, of specimen from White River bed of Colorado. Fig. 2, skull from John Day series of Oregon; *a*, side, *b*, from above, *c*, from below.

PLATE VII.

Bos taurus, dentition, two-thirds natural size; from Cuvier.

EDITOR'S TABLE.

EDITORS E. D. COPE, AND J. S. KINGSLEY.

The position of the Post-Darwinians is clearly set forth in an abstract of a lecture delivered by Prof. E. Ray Lankester, at the London Institution, which appears in *Nature* of February, 28th. Prof. Lankester declares that the error of Lamarck (and consequently of the Neolamarckians,) consists in the assumption that acquired characters can be inherited. He says, "Congenital variation is an admitted and demonstrable fact; transmission of congenital variations is also an admitted and demonstrable fact. Change of structure acquired during life—as stated by Lamarck—is also a fact, though very limited. But the transmission of these latter changes to offspring is not proved experimentally; all experiment tends to prove that they cannot be transmitted." Two inferences may be derived from these statements. First; the author of them does not believe that the so-called congenital variations can be or have been acquired; second; that he has no hypothesis to offer in explanation of the origin of congenital variations. These positions exclude another inference which nevertheless may be derived from other propositions embraced in the abstract of the lecture. He says, with Lamarck, that "change of structure acquired during life is also a fact," and also that "all plants and animals produce offspring which resemble their parents on the

whole." But in spite of these statements we are to believe that if a plant or animal acquires a useful addition to or mortification of its structure during life, this is the particular variation which will *not* be transmitted. Since the modifications acquired by use during life are necessarily useful, it seems that according to the Post-Darwinians, the only way of acquiring useful variations known to us, is excluded from the process of Organic evolution. To say the least of it, the doctrine of probabilities is severely taxed by such a position as this.

But we say further, with Professor Cunningham, that were this hypothesis true, there should have been no evolution. If acquisition during life-time, is to render a character non transmissible, the continued growth of a single character by accretions during successive generations through geological ages could not and ought not to occur. Each generation should begin where its ancestors began in the matter of useful characters, or those acquired by use, so that there could be no accumulation or development of such characters. The influence of the environment, as well as that of the energies of the living being, would be incompetent to develop more in a given generation than that generation could acquire in its single life-time. How then can evolution account for the law so beautifully displayed by paleontology, of the gradual modification of parts through long geological ages, towards given ideals of mechanical perfection? How can we account for the gradual perfecting of the articulations of the internal and external skeletons of forms which possess them? Not only is no explanation offered the Post-Darwinian school, but such progress is under their hypothesis, impossible. It is an explanation of *obscurus per obscurius*. But we are still of the opinion, in spite of Weissman's theory to the contrary, that so long as the germ plasma is subject to nutrition, it is subject to influences occurring during the adult life of an animal, and it would be an exception to all the other tissues were it not so.—*E. D. C.*

A graceful tribute to the memory of Priestly, was recently paid by the first Unitarian Church of Philadelphia. A tablet

surmounted by a bust was placed on the interior wall of the church, and services in honor of the philospher, in which several scientific men took part, were held at the time of the unveiling. Priestly was not only one of the fathers of modern chemistry; it was also as a philosopher and theologian, and as one of the founders of the first Unitarian Church of Philadelphia, that he was honored on this occasion. Though this act of appreciation has come too late for him to enjoy, it will encourage others to contribute their share to the progress of mankind.

RECENT LITERATURE.

LANG'S COMPARATIVE ANATOMY.[1]—This is the beginning of an entirely new edition of Schmidt's Comparative Anatomy, and so far as one may judge from a single part, it is to be ranked among the best of the recent text books. On every page there is a freshness both in treatment and illustration which is pleasing, while the text reads almost like a story. There is one noticeable feature in the work; it is logical in its arrangement. Thus we have as an introduction a couple of pages of an account of the cell followed by twenty on the Protozoa; next the student is introduced to the egg and spermatozoan, cell complexes and tissues, a few words concerning the Metazoa, and with this preparation we are lead to the Cœlenterates and thence to the higher forms. Several features, which though not exactly new, we do not recall in any text book, are introduced into the classification, and are usually to be regarded as improvements. Thus the division of the Cnidaria (—Cœlenterata *s. str*) into Hydozoa, Scyphozoa and Ctenophora and the limitation of the first two of these by the character of the œsophagus (ento, or ectodermal) is a valuable feature, though it disarranges our preexisting ideas and transfers the Craspedota from the Hydrozoa to the neighborhood of the sea anemones and corals. So too the separation of the Plathelmintha from the Vermes is *certainly* to be warranted on morphological grounds. The present part of the work considers only the Protozoa, Cœlenterata, Plathelmintha, and Vermes, but if

[1] Lehrbuch du vergleichenden Anatomie, von Dr. Arnold Lang. Erste abtheilung, June, 1888, pp. 290.

the succeeding parts treat the other groups as well, the whole will certainly prove a success.

BIRDS OF IOWA.—In the proceedings of the Davenport Academy Natural Sciences for 1888, there appears a catalogue of the birds of Iowa, with notes.[1] It is published only as a preliminary list and so escapes most of the criticism that might be offered, were it simply presented as a complete summary of extended observations.

Although it is offered only as *preliminary*, yet it is the most complete and reliable list that has so far appeared. It shows the authors to be familiar with the habits and habitats of all the common birds of the state and also that they have a good knowledge of many that are rare.

The authors enumerate 255 species as coming under their personal observation. Among this number are many species which have not been heretofore recorded as having been observed in Iowa, although from their known geographical distribution it was naturally supposed that they were to be found here. The maximum number of species *probably* found in the state including summer and winter visitors and Sea-birds migrating north by way of the Mississippi river,—is not much above 350.

Taking into account the fact that the collections and observations, upon which this list is based, were made chiefly in the vicinities of Charles City, Des Moines, and Iowa City, all situated in the interior of the state, and thus not affording a good opportunity for the study of many of the water birds, the work shows itself to be the result of much time and study.

For the reason just stated the list is most deficient in water birds. It is especially complete in Passerine species, when we consider the number of summer and winter, as well as Western visitors this order affords.

That the comparative completeness of the list may be readily seen the following list is appended. The first column gives the number of species which are probably to be found in the state as compiled from the known geographical distribution. The second column contains the number given in the catalogue of Messrs. Keyes and Williams.

Pygopodes	10	4
Longipennes	22	5
Steganopodes	7	2
Anseres	43	26

[1] A preliminary circulated catalogue of the birds of Iowa, by Charles R. Keyes and H. S. Williams M.D. Prof. Davenport Acad. Nat. Sci. Vol. V.

Herodiones	13	8
Paludicolæ	11	8
Limicolæ	37	21
Gallinæ	6	5
Columbæ	2	2
Raptores	34	25
Psittaci	1	1
Coccyges	3	3
Pici	10	7
Macrochires	4	4
Passeres	153	136

The work is especially valuable for the following things:

Dates of arrival and departure of summer residents.

Dates of arrival and time of stay of migratory birds breeding farther North.

Dates of arrival and departure of winter visitors.

Breeding season and nesting habits.

F. M. Fultz, Burlington, Ia.

RECENT BOOKS AND PAMPHLETS.

Bergens Museum.—Aarsberetning for 1887. Bergen 1888. From the Museum.

Campbell, John P.—Biology and its place in a liberal education. Athens, Ga. 1888. From the author.

Cornell University.—Agricultural Station, Bulletin III. From the Station.

Gage, S. H.—Microscopial Tube Length—Thickness of Cover-glass.—Form and size of the Blood Corpuscles of the Lamprey—Morphology of Muscular fibres in Minute Animals. Ext. The Microscope. 1887–8. From the Author.

Jenkins, O. P., and Everman, B. W.—Description of eighteen new species of fishes from the gulf of California. Ext. Proc. U. S. Nat. Mus. 1888. From the Authors.

Korschelt, Eugen.—Ueber die Geschlechtliche Fortpflanzung der Einzelligen und besonders der Infusorien—Ext. Kosmos 1886.—Funktion und Lage des Zellkerns bei den Pflanzen. Ext. Biol. Centralblatt viii. From the author.

Lewis, T. H.—Effigy Mounds in Northern Illinois. Ext. Science. 1888. From the Author.

McCulloch, Oscar C.—The Tribe of Ishmael, a study in social degradation. 1888. From the Author.

Minot, C. S.—Second Report on Experimental Psychology upon the diagram tests. Ext. Proc. Am. Socy. Psy. Research. 1888. From the Author.

Parker, G. H.—The eye of the Lobster. Ext. Proc. Am. Acad. 1888. From the Author.

Plateau, Felix—Rechérches Expérimentales sur la vision chez les Arthropodes; 4e partie. Bruxelles. 1888. From the Author.

Plateau, Felix—Rechérches Expérimentales sur la vision chez les Arthropodes Vme partie. Bruxelles. 1888. From the Author.

Rice, Wm. N.—Science-Teaching in the Schools. Ext. Am. Nat. 1888. From the Author.

Weismann und Ischikawa.—Weitere Untersuchungen zum Zahlengesetz der Richtungskörper. Ext. Zool. Jahrbuch. 1888. From the Authors.

GENERAL NOTES.

GEOGRAPHY AND TRAVEL.

THE STATE OF MICHOACAN.—Michoacan is one of the richest and most fertile of the states of Mexico, rich in woods, in mines, and in capacity of cultivation. Along with part of Guanajuato, it formed the ancient kingdom of Mechocean. Its extent is 55,693 sq. kilometres, its population about 800,000. The entire state is mountainous, and a considerable portion is occupied by lakes, among the principal of which is that of Patgcucero. The coast line is 163 kilometres long and contains the ports of SanTelmo, Bucerico and Marauta. Among the principal peaks of the state are Tarcitaro (3,860 m.), Patambon (3,750 m.), Quinceo (3,324), Tarimangacho (3,104), Zirate(3,340), and San Andres (3,282).

BOLIVIA.—According to an interesting article in the last issue of the Spanish Geographical Society, the area of Upper Peru, now known as Bolivia, is 2,115,329 kilometres, or rather more than four times that of Spain. Its population, according to a census taken in some departments, and calculations made in others, is only 1,182,270, a figure considerably below previous calculations. The engineer Minchi gives the altitude of La Paz as 3,641 m., that of Lake Titicaca at 3,824 m., and

that of the peak of the Illimani as 6,488 m. This height agrees well with the average given by other surveyors. Sorata is thirty or forty metres higher. Among other elevated peaks are Chachacomani (6,203), Hauina (6,184), Murudata, (5,120) Sunchulli (5,546), and Tres Cruces (5,504). All of these as well as Sorata and Illimani are in the department of La Paz. In that of Oraro are Sajama (6,546), Parinacocha (6,376), Pomerape (6,260), Azanagues (5,136) and Guanani (3,968). In Pobors are the peaks of Charague (5,603), Potosi (5,830), Nuevo Mando (5,949), Lipez (5,982), Taguegua (5,704), Guadalupe (5,754), Esmeraca (5,406), Tazna (5,105), and Ubina (5,203), and in Cochabamba that of Tunare (4,726). The most elevated inhabited places are: Tolapalca (4,290), Potosi (4,166), in its highest part, Catamarca (4,141), and Oruro (3,792). The great tableland between the two ranges of the Andes has an average elevation of 3,800 metres.

The mountainous part of Bolivia may be divided into four regions: (1.) that between the sea and the high plateau, poor in vegetation but rich in minerals and salts; (2.) the plateau itself, also poor in its flora, but rich in mines of every class; (3.) the region of the valleys formed by the lateral chains of the interior of Royal Andes, the chains which unite the two main ranges, and the buttresses of the interior range—this is a most fertile country with exuberant vegetation; and (4.) the eastern plains, a land of virgin woods and wilds.

Among the valleys of the third region may be mentioned those of Beni, Santa Cruz, and Cinti, the last famous for its wines. The *yungas* are deep valleys, whose temperature never descends below 21° and rises to 45 C.

In the E. and N. are the great flats of Beni, Santa Cruz, Chiquisaca, and Tarija. The river Beni and its tributaries inundate these flats in the flood season, leaving large lagoons, and giving rise to insalubrious conditions. More to the E. the Paraguay also inundates the flats of Manzo and Gran Chaco, forming the Tarayas lakes. Between the Paraguay and Pilcomayo are great salt lakes, the most notable of which is Izozo. Some sierras arise in the eastern part, on the confines of Brazil, the most easterly that of San Simon.

The greater part of the rivers of Bolivia are affluents of the Amazons or the La Plata, and are navigable. Only one river, the Loce, reaches the Pacific, all others are lost in the Atacama desert.

About a third of the population is white, the rest for the most part Indian or Mestizo. Among the higher classes of the

whites, French customs prevail, but the Chulos or Mestizos still wear the dresses they wore when they were Spanish subjects.

EUROPE.—GEOLOGICAL WORK IN SPAIN.—The two first volumes of the Commission of the Geological map of Spain treat of the geology and mineralogy of the province of Huelva, and will be followed by two other volumes treating of the petrography of the same province. The same Commmission has also published the fourteenth volume of its bulletin, which is almost exclusively occupied by a description of the lower cretaceous formation of, by Sr. L. Mallado, forming part of a Palæontological Synopsis of Spain, which commenced with the ninth issue of the same bulletin. The general geological map of Spain, consisting of thirteen sheets, is also almost complete. The Commission of Mining Statistics has also published a map of the peninsula showing the areas conceded in each province for the exploitation of various minerals. The Hydrographical Commission has not only published the plans of various parts of the Mediterranean coast, but is at work upon those of the Philippines.

ENGINEERING WORKS IN EUROPE.—Among engineering works of geographical importance now being carried on in Europe, are the canal across Schleswig from the North Sea to the Baltic, commenced in June, 1887, and likely to be finished next year; and the construction of a railway from Belgrade to Salonica. In Italy a project is on foot to convert Rome into a sea-port by forming a canal from the south-east part of the city to the coast. As the Tiber, at the highest point of the canal, is but twelve metres above the level of the sea, the project does not involve any very great difficulty.

A new port for the city of Bilboa is also projected. Belgium is commencing a series of fortifications upon the river Meuse to protect the territory in case of a new Franco-German war.

SARDINIA.—From the fourteenth to the sixteenth century, during the time that Sardinia belonged to Aragon, the official language of the island was that of Catalonia, but this was superseded by the Castilian tongue after the union of Aragon and Castile. Nevertheless the Catalan language is still spoken at the northern end of the island, where, at the foot of Nurra, the Catalan Sr. Toda, found himself perfectly

understood. In Alguer, an ancient walled city of 12000 inhabitants, the names of the streets are Catalan as are also the speech of the populace and the songs of the children. Since the Peace of Utrecht in 1720, the Castilian tongue has given way to the Italian, yet even within its capital, Cagliari, the Spanish tongue is still used in the nunnery of Santa Clara.

THE MOUNTAIN RANGES OF SPAIN.—The highest peaks of the Pyrenees, according to the recently issued, "*Reseña Geographica y Estadistica de España*, are Nethon, 3404 metres; Pico de Posets, or Landana, 3,367 m.; Maladetta or Montes Malditos, 3,354 m.; and Tres Sorores or Mont Perdu, 3,351 m.

The northern range of the Iberian peninsula is by D. J. Bisco considered as composed of two sections, the one east, the other west, of the northern end of the Iberian range, which is that which forms the western border of the Ebro valley, and which prolongs itself southward sufficiently to form a base from which rise the ranges running east and west between the various rivers of Castille and Andalucia. The highest peaks of the Vasco-Cantabrian or eastern portion of the northern cordillera are: Peña de Cerreda, 2678 m.; Peña Vieja, 2639 m.; Peña Prieta, 2520 m.; and Contes 2373. The two highest peaks of the western or Galicio–Asturian part of the northern range are: Espiguete 2453 m.; and Peña-Ubina, 2300. The Iberian, or north and south system, the highest portion of which is known as the Mountains of Burgos, has no peaks comparable to those of the Pyrenees, its three highest summits being Moncayo 2315 m,; San Lorenzo, 2303 m.; and the Picos de Ebibron, which rise to 2246 metres. The city of Burgos stands at a height of 856 metres.

The ranges which run westward from the Iberian are the Central, between the basins of the Duero and Tajo (Tagus); the Toledo Mountains, between the Tajo and the Guardiana, the Sierra Morena, and the Sierra Nevada. The highest summits of the Central system are: Plaza del Moro Almansor 2,650 metres; Calvitero 2,401 m.; Peñalara 2,400 m.; and Hierro 2,383. The city of Avila stands at a height of 1,126 metres, Segovia at 1,000, and the Observatory of Madrid is 655 metres above sea level. None of the Toledo Mountains attain great elevations, the loftiest being Corocho de Rocigalgo 1,448 metres and Vicente 1,429 m. Still more insignificant is the elevation of the Sierra Morena, which rising but slightly above the plains of Castile, may be regarded as little more than a huge step from those plains, to the valley of the

Guadalquiver. The highest points are, Estrella 1,299 m., and Rebollera 1,160 m.

South of the Guadalquiver, the Penibetic system culminating in the Sierra Nevada, though less continuous and extensive than the Pyrenees, attains in some points elevations second only to the Alps. The two loftiest peaks, Mulhacen 3,481 m., and Veleta 3,470 m., are both near Granada. Next in height come the Cerro de la Alcazaba 3,314 m., and the Cerro de la Caldera 3,289 metres.

AFRICA.—THE MUNI QUESTION.—According to a paper read by Sr. F. Coello, before the Geographical Society of Madrid, (Jan 9, 1889) the rights of Spain in the Gulf of Guinea date from a treaty made with Portugal in 1777, by which the island of Santa Catalina and the Spanish colony of Sacramento (in Brazil) were ceded to Portugal in exchange for the islands *Fernâo do Poo* and *Anno Bon*, together with the right to treat with the natives in all the neighboring coasts, from Cape *Formozo* at the mouth of the Niger, to Cape *Lopo Gonçalves*, or Lopez, S. of the *Gabâo*. (The Portuguese orthography is here given). Portugal had the right to dispose of these coasts, not only from having discovered them, but from having occupied the Cameroons, the Gaboon (where some relics of the Portuguese dominion have been found), and some points in the interior. In 1778 this treaty was ratified, and a Spanish expedition took possession of Fernando Po and Anno Bon. In 1827 the English occupied the former island, but afterwards surrendered it, and proposed to purchase it for 1,500,000 francs. This proposal was refused, and in 1843 an expedition took possession of both the above islands and of Corisco. The king of Corisco and of the Vengas tribes, who inhabit the neighboring coasts and the banks of the Muni, also acknowledged the sovereignity of Spain. No nation but France has disputed the rights of Spain upon the Muni, nor did France dispute them until many years later. In June, 1843, the French took possession of a blockhouse at the mouth of the Gaboon, the site of the present Libreville, but all annexations since made by France have been to the southward. Various treaties, letters of nationality, etc., have since bound the natives of various parts of this territory to Spain.

The first claim of France dates from May, 1860, and proceeded from the governor of the Gaboon. In 1883 the French openly claimed the territory, not only as far as the river Campo, (the northern boundary of the Spanish possessions)

but even to and beyond the Cameroons. The Germans, who later on commenced to treat with the natives of this part of the coast, recognized in 1885 the rights of Spain as far north as the river Campi. In various expeditions under Dr. Ossario, Ivadier, and the governor Sr. Montes de Oca, the basins of the Campo, Benoto or Eyo, and Muni, were explored, and as many as 370 chiefs recognized the rule of Spain. The territory thus embraced covers about 50,000 sq. kilometres, and if the strip is carried inwards between the same degrees of latitude to the Ubangi, parallel to the French possessions, would contain at least 180.000 k. It is, moreover, a fertile and thoroughly well-watered country, well-wooded and capable of great production.

THE CITY OF WAZAN.—It is extraordinary and almost unexampled, says Don T. de Cuevas, in a recent issue of the *Boletin of the Madrid Geographical Society*, to meet among the most remote folds of the Masamoda mountains a city of at least 11,500 inhabitants, a centre of mercantile activity and of traffic among semi-independent kabyles, the seat of a religious power that at the commencement of this century made the monarchs of the Magreb tremble on their throne, and the residence of Xarifes who descend from kings and even from a higher stock, since in their veins runs the blood of Mohammed. Uazzan has various orthographies, the French know it as Ouezzan, the English as Wazan.

When at the destruction of Baurce, 979-84 A.D. the Edrisite power was overthrown, part of the Edrisites took refuge in the Uad Droa, and established themselves in Axyen, a town of Arjona, at the beginning of the XVI. century, a little after the Xerifes Saadies had acquired the throne of Morocco. From Axyen, the emir Muley Abdallah changed his residence to Wazan. The consent of this Xerif is necessary in order to make the election of the Sultan legal.

GEOGRAPHICAL NOTES.—The Hungarian, M. Dechy has ascended Elbourz and has reconnoitred the glaciers which surround that peak; and M. Trillo has explored the right bank of the Volga and has discovered the ruins of an ancient city, in which, from the marbles, aqueducts, and Arab, Persian, and Tartar coins met with, a high civilization must have existed.

Two small sections of railway have at last been opened in Persia, one from Teheran to Xahzade-Abdulazin, the other from the coast of the Caspian to Amal, the capital of the

province of Mazanderan. A line uniting the Persian gulf and the Caspian sea is also spoken of.

The Germans accuse the English of delaying the rectification of the bounderies between the possessions of the two countries in the Niger region, until they had made sure of their claims over the Upper and Central Binue by means of treaties with the native chiefs. France and England dispute the protectorate of the Egba territory, situated to the north of Porto Novo and Lagos. The English claim that the natural route to Abeokuta, the Egba capital, is by the river Ogun, which disembogues at Lagos, while the French claim that it can be reached as readily by the French river Addopero. The truth is that the Frenchman M. Viard has got ahead of the English in treating with the Egba king.

The expenses of the Congo Free State during 1887, have amounted to 1,891,190 francs, spent in political and judicial administration, transport and mails, constructions, geographical explorations, etc. The receipts are not given, but they must be small, since at present ivory is the only article of commerce.

The treaty by which the Sultan of Zanzibar conceded the greater part of the coast of Zanguebar to Germany, came into force the 15th of August last, but the rebellion of the natives of Pangani has spread along the coast and makes German domination difficult. It is said that at the present time the Germans have abandoned the only two points they had occupied viz: Bagamoyo and Dar-es Salam.

Turkey has sought to reclaim the port of Zeila, in the gulf of Aden, asserting that it was yielded to Egypt on condition of an increased tribute; but England asserts that the said port is in the Egyptian dominion. In the meantime Zeila remains in the hands of England.

Among the boundary disputes which are common in America, there has now risen one which is also a question of money. Rich gold fields have apparently been discovered in Dutch Guiana, between the rivers Lava and Papanaom; but the French call to mind that both these rivers are affluents of the Marouine, which forms the boundary between the two colonies, and therefore doubt the right of the Dutch to the territory.

According to a provisional treaty concluded between Bolivia and the Argentine Republic, the boundary between the two countries follows the parellel of 22° S. from the Paraguay to the Pilcomayo, thus leaving the two coasts of the navigable part of the latter river in the possession of the last named country.

Last March the French took possession of the Society islands, it is said, at the invitation of the inhabitants, but some of the natives of the island Raiatea attacked a French detachment. England has taken possession of the Fanning islands, south of the Sandwich group. England has also acquired the island of Rarotonga, which is advantageously placed between Panama and Australia, and which France considered as a natural connection between Tahiti and New Caledonia.

Germany has declared the neighboring Tonga group, which England intended to take possession of, to be neutral in accordance with the agreement signed by both powers April 6, 1886.

GEOLOGY AND PALÆONTOLOGY.

CREDNER ON PALÆOHATTERIA. The seventh part of Dr. H. Credner's account of the Stegocephali and Saurians found in the "Plauens'ch Grounds," near Dresden, is devoted to the above-named interesting genus of Reptilia. A single species is embraced in the genus, *P. longicaudata* Credner. This animal was of about the size of the *Sphenodon punctatum* of New Zealand, and presents so many points of affinity, that Dr. Credner places it in the same order, the Rhynchocephalia, and even in the same family, the Sphenodontidæ.

An examination of Professor Credner's description and the figures with which it is abundantly illustrated, shows that its describer has not overrated the importance to biology of its discovery. But its nearest ally is not, as Professor Credner supposes, the *Sphenodon punctatum* of New Zealand, but the fossil *Stereosternum tumidum* from the probable carboniferous formation of Brazil. It differs widely from Sphenodon in the character of the pelvis, agreeing in this with Stereosternum, and with the Pelycosauria. It differs from the Pelycosauria in its two postorbital cranial arches, and in its single-headed ribs, agreeing in the latter point with both Stereosternum and Sphenodon; and probably in the former point also, but the character of the cranial arches in Stereosternum remains unknown. It agrees also with the Brazilian genus in the characters of the tarsus, and differs more from the Pelycosauria and less from the Sphenodon. The humerus is also like that of Stereosternum.

The conclusion is that Palæohatteria is one of the Proganosauria, and that it is probably a member of the family of the Stereosternidæ. The division Proganosauria differs from the Rhynchocephalia by the structure of the pelvis.

Since the above was written, a review of Professor Credner's paper, by Dr. G. Baur, appeared in the February number of the *American Journal of Science and Arts*. His conclusions are similar to those reached by myself.—E. D. COPE.

BROGNIART AND DÖDERLEIN ON XENACANTHINA. Thanks to these authors we are now well acquainted with the structure of this important type of palæozoic fish. M. Brogniart[1] has described the structure of the skeleton, and Professor Döderlein[2] gives us that of the skull. The former bases his observations on numerous specimens from Commentry, and the latter on material from the coal formation of Alsace. He shows that it is nearly allied to Didymodus from the North American Permian, and represents the same ancestral type of fishes. The cranial structure is that of an Opistharthrous shark; that of the lateral fins is of a Dipnoan type; while the characters of the median fins are those of a primitive Teleostome, as seen in some Crossopterygia. There is a well developed hyomandibular; and the toothed spine, long known as a separate body, and first identified by Kner, is articulated with the posterior median part of the cranium. The pectoral fin is unsymmetrically bipinnate, and the ventrals are unipinnate. They arise from a lateral cartilage, and terminate in a simple, elongate, fringed plate, which is the position of the male organ of the sharks. The vertebral centra are unossified, but intercentra and mesial spines are present, the former supporting short ribs. The dorsal fin is especially interesting, as displaying one of the primitive stages of development of this organ. It is distinguished by the enormous size of its basiosts, which, as in Lepidosiren, are articulated with the axinosts. The fin radii also articulate with the baseosts, thus differing from the Lepidosirenidæ, and agreeing with Pheneropleuron. And all these support with the neural spines, confirming the view which I have taken of the original relation of the fins to the vertebral column.

Dr. Döderlein agrees very nearly with the position assigned this division (the Ichthyotomi) by the present writer, except that he thinks that it should be separated from the Elasmo-

[1] Etudes sur le Terrain Houillier de Commentry, par C. Brogniart et E. Sauvage.

[2] Zoologischer Anzeiger, 1889, March 4th.

branchii and maintained as a distinct class like the Dipnoi. He employs Lütken's name, Xenacthini for it, but this must be clearly retained for the subdivision of the Ichthyotomi to which Xenacanthus properly belongs. If for instance, it should be discovered that Acanthodes belongs to the Ichthyotomi, (AMERICAN NATURALIST, 1887, p. 1016) the Xenacanthini and Acanthodini would be two of its primary divisions.

It is to be regretted that M. Brongniart was not better acquainted with the work done in America on this group, as he would have been thus spared the necessity of making some new names.—E. D. COPE.

CROLL ON MISCONCEPTIONS REGARDING THE EVIDENCE OF FORMER GLACIAL PERIODS. In a paper read before the Geological Society of London, January 23, 1889, Dr. James Croll made the following statement:—

The imperfection of the geological record is greater than is usually believed. Not only are the records of ancient glacial conditions imperfect, but this follows from the principles of geology. The evidence of glaciation is to be found chiefly on *land-surfaces*, and the ancient land-surfaces have not, as a rule, been preserved. Practically, the several formations consist of old sea-bottoms, formed out of material derived from the degradation of old land-surfaces. The exceptions are trifling, such as the underlayer of coal-seams and dirt-beds, like those of Portland. The transformation of an old land-surface into a sea-bottom will probably obliterate every trace of glaciation; even the stones would be deprived of their ice markings; the preservation of boulder-clay, as such, would be exceptional. The absence of large, erratic blocks, in the stratified beds, may indicate a period of extreme glaciation, or one absolutely free from ice. The more complete the glaciation the less probability of the ice-sheet containing any blocks, since the rocks would be covered up. Because there are no large boulders in the strata of Greenland or Spitzbergen, Nordenskiold maintains that there were no glacial conditions there down to the termination of the Miocene period. The author maintained that glaciation is the normal condition of polar regions, and if these at any time were free from ice, it could only arise from exceptional circumstances, such as a peculiar distribution of land and water. It was extremely improbable that such a state of things could have prevailed during the whole of the long period from the Silurian to the close of the Tertiary.

A million years hence, it would be difficult to find any trace

of what we now call the glacial epoch; though if the stratified rocks of the earth's crust consisted of old land-surfaces, instead of old sea-bottoms, traces of many glacial periods might be detected. The present land-surface will be entirely destroyed, in order to form the future sea-bottom. It is only those objects which lie in existing sea-bottoms which will remain as monuments of the post-tertiary glacial epoch. It is then probable that the geologist of the future will find in the rocks formed out of the non-existing sea-bottom more evidence of a glacial epoch during post-tertiary times than we now do of one, say, during the Miocene, Eocene, or Permian period. Palæntology can afford but little reliable information as to the existence of former glacial periods.

THE VERTEBRATA OF THE SWIFT CURRENT RIVER, II. In the NATURALIST for 1885, p. 163, the writer gave a brief account of the vertebrata of the above locality obtained by the Geological Survey of the Dominion of Canada. Explorations set on foot by the Director of the Survey, Dr. A. R. C. Selwyn, during the year 1888, resulted in the obtaining of a number of additional species, some of which are of considerable interest. In describing these, I will enumerate those already known from that locality. The specimens are generally in a fragmentary condition, owing to the conglomeritic nature of the deposit. The new material was obtained by Mr. T. C. Weston, of the Survey. The total number of species is seventeen.

PISCES.

Amia sp., numerous vertebræ.

REPTILIA.

Trionyx sp., Ann. Report, G. N. H. Survey, Canada, 1885, c. p., 79.

Stylemys sp. loc. cit.

MAMMALIA.

Rodentia.

Palæolagus turgidus Cope, loc. cit.

Bunotheria.

Hemiopsaldon grandis Cope, loc. cit., and American Naturalist, 1885, p. 163.

Ancylopoda.

Chalicotherium bilobatum sp. nov.

Founded on a mandibular symphysis and part of the left ramus of an adult animal, which contains the alveoli of the anterior four molars, and part of that of the fifth. All the premolars are two-rooted, showing that they are but three in number. Canines and incisors wanting, the anterior alveolar margin thin and little prominent, and bilobed, with a median emargination. Symphysis coössified, with an angulate inferior margin, posteriorly with a fossa on each side of the median line, sloping regularly upwards to the alveolar margin, and concave above behind the margin. Minute traces of alveoli of a canine and two incisors on each side, which were probably present in the fœtus. Length of symphysis above, 120 mm.; depth posteriorly, 48 mm. Length of symphysis in front of p. m. iii. Length of premolar series, 75 mm. Length of m. i., 40 mm.

Although this is the first announcement of the discovery of the genus Chalicotherium in America, it is not the first discovery. Professor Scott showed me a series of superior molars from the Loup Fork formation of Kansas, from the Agassiz Museum, which he identified as belonging to this genus. The present species is of larger size than the Kansas form, and is apparently equal to the *C. goldfussii* of the Upper Miocene of Europe. The occurrence of this form in the Lower Miocene (White River), as well as the Upper Miocene (Loup Fork), of this country, is a noteworthy fact, but is parallel to its history in Europe. Described from the upper Miocene by Kaup, it was afterwards found in the middle Miocene (*C. grande*) by Lartet, and in the Upper Eocene (*C. modicum*), by Gaudry.

The remarkable character of this genus, as discovered by Filhol, has been already mentioned in the NATURALIST.[1] It has little relation to the family of Perissodactyla, to which it has given the name, and which it so resembles in molar dentition. It must form a family by itself, and the genera with which it has been associated must form a family to which the name Lambdotheriidæ may be applied. The anterior ungual phalanges of Chalicotherium are of prehensile character and not ungulate, but rather unguiculate. The phalanges resemble those of the Edentata, but the carpus and tarsus are, according to Filhol, diplarthrous in structure, while the Edentata are taxeopodous. We have in the Chalicotheriidæ the antithesis of the Condylarthra. While the latter is ungulate with an unguiculate carpus and tarsus, the former is unguiculate with an ungulate (diplarthrous) carpus and tarsus. Thus

[1] Osborn on Chalicotherium, 1888, p. 728.

the Chalicotheriidæ must be referred to a distinct order of unguiculate Mammalia, which I propose to call the Ancylopoda, with the above definition. Two genera belong to the single family, the Chalicotheriidæ; viz., Chalicotherium Kaup, and Ancylotherium Gaudry. In the former, the phalanges are distinct; in the latter the first and second are coössified (Lydekker). Marsh has not yet shown how his genus Moropus differs from Ancylotherium. The species described by Marsh under this name are from the Loup Fork bed of Kansas.

Perissodactyla.

Haplacodon augustigenis, Cope, gen. nov. *Menodus angustigenis*, Cope, Annual Report, G. N. H. Survey, Canada, 1885. C, p. 81.

Char. gen. Additional specimens of the species described, as above cited, show that it cannot be referred to the genus Menodus, but that it belongs to the family Lambdotheriidæ (Chalicotheriidæ *olim*) as at present defined. It differs from all the genera of the Menodontidæ in the presence of but a single internal cusp of the first (posterior) superior premolar, a fact which renders it highly probable that the premolars which precede it in the maxillary bone, were similarly constituted. It differs from all other genera of Lambdotheriidæ and also from Diplacodon, to which it is allied, in the presence of but two inferior incisors on each side. It is not certain whether it possesses horns or not.

Menodus sp. Cope, Ann. Report, l. c. p. 83.

This species is allied to the *M. gigantcus* Leidy, but whether identical or not can not be yet ascertained.

Anchitherium westoni sp. nov.

This species is represented by a single superior molar, and two inferior molars, the latter in place in a part of the mandible. The teeth are smaller than those of the *A. bairdii*, from which they also differ in their greater transverse as compared with their anteroposterior diameters. The intermediate tubercle of the posterior crosscrest is more distinct than that of the anterior, and the posterior intermediate cingular cusp, so prominent in the *A. bairdii*, is here wanting. The posterior cingulum continues round the internal base of the posterior internal cusp. Diameters of superior molar; transverse, 13.5 mm.; anteroposterior, 10 mm. Diameters of inferior molar; transverse, 8 mm.; anteroposterior, 10.5 mm. This species, interesting for its primitive character in the absence of the

posterior cingular cusp, is dedicated to Mr. T. C. Weston, the explorer of the region from which these fossils were obtained.

Aceratherium mite Cope, l. c.

Aceratherium pumilum Cope, l. c.

Artiodactyla.

Hypertragulus transversus sp. nov.

Indicated by two superior molar teeth of old individuals. They are of nearly twice the linear dimensions of the only known species, *H. calcaratus* Cope. The external cusps are subconical, and the external rib which separates them in Leptomeryx is wanting here. Anterior cingular cusp small. The anterior bone of the posterior internal crescent enters the notch between the external cusps but does not fuse with either of them. Slight cingula on the anterior and posterior sides of the internal lobes which do not pass round their internal sides. No external cingulum. Diameters, anteroposterior, 12 mm.; transverse (at base) 15 mm. Crown very brachyodont.

Leptomeryx esulcatus sp. nov.

A single superior molar indicates this species, which is of about the dimensions of the *L. evansii.* It differs distinctly from this Tragulid, in the greater convexity of the external face of the external cusps, and the absence of the sulci which define an external median rib of that surface in the *L. evansii.* The rib which bounds the external faces of the cusps from each other is present. Anterior external cingular cusp small, continuous with anterior cingulum. No internal nor external cingulum. Diameters of crown; anteroposterior, 6.5 mm., transverse, 7.5 mm.

Leptomeryx mammifer Cope, Report, G. N. H. Survey, Canada, 1885, C p. 84.

Four superior molars add to the characters already derived from mandibular teeth as above cited. The median and anterior external cingular cusps are large and obtusely subconical. The anterior external cusp has a very strong median external rib, while the posterior has a very weak one. The anterior horns of the internal crescents are much produced; the posterior but little. The cingula are slight, and are not continued round the internal base. Diameters of superior molar; anteroposterior, 11 mm.; transverse, 11.5 mm.

Leptomeryx semicinctus sp. nov.

A large species possessing twice the linear dimensions of the *L. evansii* in the superior molar teeth, is represented by three

of the teeth designated. In these the external crescents are more compressed and less conical than the two species above described, resembling more nearly those of the *L. evansii*. The posterior has a weak vertical rib; the anterior a strong one. The external cingular cusps are thoroughly fused with the external crescents, forming their anterior horns. The anterior horns of the internal crescents are a little more produced than the posterior. No external or posterior cingulum; a much interrupted anterior cingulum, which is continued round the internal base of the anterior crescent, which is further continued on the anterior side of the internal base of the posterior crescent. Enamel finely wrinkled. Diameters; anteroposterior 14 mm.; transverse, at base, 15 mm.

Oreodontidæ, an inferior first premolar.

Elotherium mortoni Leidy; l. c.

Remarks.

The continued scarcity of Oreodontidæ is matter of surprise. Their place is supplied so far, by an increased number of Tragulidæ (four species). The presence of a genus of Lambdotheriidæ, Haplacodon, increases the impression of antiquity of the fauna produced by the presence of a Creodont (Hemipsalodon.)

MINERALOGY AND PETROGRAPHY.[1]

PETROGRAPHICAL NEWS.—Interbedded with the Tertiary schists of the western Cordilleras in Peru and Bolivia, are andesites, which are divided by Rudolph[2] into a western area of pyroxene-andesites, an eastern area of horn blende-andesites and a middle area of a variety intermediate between these two. The structure of each class varies from those types in which there is a devitrified glassy groundmass, to those in which the groundmass is microcrystalline. The plagioclase is andesin that has suffered alteration in the center because of the more basic character of this portion. The pyroxene-andesites contain augite twinned parallel to $P\bar{\infty}$, and also an orthorombic pyroxene with a cleavage parallel to $\infty P\bar{\infty}$ and a parting parallel to $0P$. Both augites have in some cases undergone alteration into bastite. By an increase in the amount of hornblende the

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Maine.

[2] Miner. u. Petrog. Mitth. ix. p. 269.

pyroxene variety passes over into the typical hornblende-andesite through stages in which hornblende and pyroxene are both present, the amount of the one increasing with diminution in the amount of the other. The hornblende is often surrounded by an opacitic rim in which are frequently numerous little crystals of augite. Tridymite is both an original and a secondary constituent in all varieties of the andesites, with the exception of the dacites in the extreme eastern portion of the area studied, where the silica is in the form of opal and porphyritic quartzes. The biotite present in many specimens contains apatite and rutile inclusions regularly arranged, the former with their long axes perpendicular and parallel to the *c* axis of the mica, and the latter cutting each other at angles of 60°. The author describes the course of a silicification process which has taken place in some of the rocks, and also the eutaxitic structure noted in many of them.—Of the Andes mountains in Colombia four distinct ranges are recognized, viz: the Western, Central, Eastern and Coast Cordilleras. The structure and the rocks of the Central and Eastern ranges have recently been studied by Hettner and Linck.[1] In the former granite, gneiss, crystalline schists, diabase, dacites, andesites and clay slates occur. The crystalline schists and the slates are regarded as Archaean. In the Eastern range none of the younger rocks were found, except a tuff composed of andesite material. Among the older rocks found in this area may be mentioned a quartzite and a felsophyre.—In a beautifully illustrated paper on the rocks between the Province of Minas Garaes and São Paulo, in Brazil, Machado[2] describes the gneisses and the sedimentary rocks of the region, nepheline-syenite, quartz-augite-diorite and olivine-diabase. The last mentioned rock occurs in dyke form and presents no unusual features. The diorite forms a stock in the gneiss. It contains in addition to its essential constituents also hypersthene and scapolite. The most interesting portion of the paper is that devoted to the nepheline-syenites. These are pre-Devonian and form the plateau of Poços de Caldas. Three types are distinguished —a coarsely granular, a fine grained and a dense and porphyritic type. They all contain the same components, viz: orthoclase, nepheline, aegerine, biotite, sodalite and cancrinite (as a decomposition product of nepheline), and grade over into one another. Wollastonite, lovenite and epidote also occur in some specimens as accessory constituents. Darker fine

[1] Zeits. d. deutsch. geol. Gesell. XL. 1888. p. 205.

[2] Miner. n. Perog. Mitth. IX. p. 318.

grained varieties of the rock often appear as if included in lighter colored coarser grained kinds, the color of the two rocks depending upon the percentages of augite in them. The dense varietiesoften show a fluidal structure in the arrangement of little microlites of augite, and sometimes possess these in dendritic groups. Rutile is noted as an alteration product of sphene, and several unknown minerals are briefly described.—In an English summary at the end of his book[1] Reusch gives a description of the remarkable geological region of Norway where eruptive, sedimentary, vein and dyke rocks have had developed in them by the action of great pressure, a schistisity which was attended by chemical change in the original constituents of he rock masses. Through processes carefully described the author shows that granite may originate from clastic rocks and afterwards be intruded as an eruptive into other eruptive and clastic rocks in the form of dykes. Gneiss veins are said to be common in the region, and schistose gabbro, diabases and other basic rocks occur in great quantity. The book contains three colored maps and two hundred-and-five wood-cuts of geological sections and sketches of thin section of rocks. From his observations, Reusch draws some important conclusions which will probably explain many of the difficulties met with in solving the problems of the origin of crystalline schists.—A hornblende-peridotite[2] from a hill at the south foot of Kilimandjaro in E. Africa is an allotriomorphic granular aggregate of grass-green hornblende, salmon colored hypersthene and colorless olivine. The hornblende and olivine include rows of opaque rod-like bodies. The hypersthene is pleochroic as follows: a = salmon-red; b = pale yellow; c = sea-green. Pleonast and magnetite are among the other constituents.—A few small isolated patches of a green rock occurring just north of Aberdaron in North Wales, and colored as serpentine on the survey maps of Wales are regarded by Elsden[3] as serpentinized diabases. Unaltered diabases, hornblende-gabbros, and porphyrites from the same region are also briefly described by the author.—Mr. Wethered[4] has discovered well outlined quartz crystals in the insoluble residues of the Carboniferous limestones at Clifton, England, that have resulted by the enlargement of fragmental quartz grains by the deposition of silica derived from organic sources.—In the

[1] Bommeloen og Karmoen med. omgivelser geologisk beskrevne. Kristiania. 1888.
[2] Hatch; Geol. Magazine, May, 1888. p. 257.
[3] Geol. Magazine, 1888. p. 303
[4] Quart. Jour. Geol. Soc. May, 1888. p. 186.

course of a paper on the Huronian rocks from Sudbury, Canada, Bonney[1] describes altered feldspar fragments in a conglomerate, that have given rise to flakes of mica and interlocking grains of quartz. He points out that the same change on a larger scale might produce a gneiss—a result which has already been indicated by Van Hise.[2]—A rock composed entirely of a mosaic of hornblende and biotite is mentioned by Horton[3] as having been collected at Dosky Sound, New Zealand.—Jade has been found by Von Fellenberg[4] on the contact between limestone and serpentine on the Pizzo Lunghino, near the Maloja Pass in the Alps.

MINERALOGICAL NEWS.—In a Bulletin of the New York State Museum[5] F. L. Nason describes some fine crystals of brown *tourmaline* from Newcomb, Essex Co., N. Y. of *pyroxene* from Ticonderoga in the same county, and of some *calcites* collected by the late Prof. E. Emmons at Rossie, St. Lawrence Co. The brown *tourmalines* occur in Laurentian limestone, and present in general the features of the well-known Gouverneur mineral. They are associated with graphite, apatite, sphene, wernerite, quartz, zircon, muscovite, albite, tremolite, pyroxene and pyrite. Some of the crystals are of large size and others are so flawless as to have yielded fine gem material. A characteristic grouping is that in which a number of parallel growths are terminated at one end by a form common to the entire group, while at the other end each individual has an independent termination. Some of the *sphenes* exhale a feted odor when struck, and many of them include rutile needles with a distinct crystalline form. *Dipyr* crystals of large size are glassy or transparent and enclose crystals of sphene and opaque acicular inclusions arranged with their long axis parallel to the *c* axis of the dipyr. The *calcite* crystals from Rossie are remarkable for the fact that they are all twins. The most common twinning plane is ^{c}P. Twins parallel to ∞P are also quite frequent. Often trillings occur in which two of the crystals are twinned according to one law, and are twinned with reference to the third crystal in accordance with the second law. One set of rhombohedral faces is smooth and glistening while the second set is rough. The pyroxenes are from a vein

[1] ib. Feb. 1888. p. 32.

[2] Amer. Jour. Sci. xxxi. p. 453. AMERICAN NATURALIST, Aug. 1886. p. 723.

[3] Quart. Jour. Geol. Soc. Nov. 1888. p. 745.

[4] Neues Jahrbk für. Min., etc., 1889. I. p. 103.

[5] No. 4. Aug. 1888. Albany.

of calcite in gneiss, which vein has been worked for graphite. These pyroxenes are sometimes eighteen inches in length and thirty-six inches in circumference, and exhibit a parting parallel to oP. The pyroxenes are thought to be older than the calcite but younger than the quartz with which they are associated.—Interesting parallel growths of *andalusite* and *sillimanite* are described and figured by Lacroix[1] from Ceylon and from a metamorphic rock from Morlaix, Finistère, France. In the former instance the two minerals are intergrown with their *c* axes parallel, and in addition two other series of sillimanite crystals cross the principal one at angles of 90° and 45°. The same author finds that *bamlite*, *monrolite*, *bucholzite*, *xenolite* and *wörthite* are either merely peculiar forms of sillimanite or impure varieties of this mineral.—Two *barium feldspars* from the manganese mines of Söjgrufran, Grythyttan, Sweden have been analyzed by Igleström.[2] The first is a red mineral and the second is white and transparent. Both are insoluble in acids. Their analyses yielded:

	SiO_2	Al_2O_3	FeO	MnO	BaO	MgO	CaO	Na_2O	K_2O
Red feldspar	61.90	15.80	5.00		9.58	1.30	.40	6.02	
White feldspar	54.15	29.60			1.26	1.52	1.00	12.47	

According to Des Cloizeaux the white mineral has the optical properties of albite.—The same mineralogist records the analysis of a clear straw yellow *pyrrhoarsenite*[3] from the same mine. Its composition corresponds to the formula 10 (Ca. Mg. Mn.)$_3$ $(AsO_4)_2$ + Ca_2 Sb_2O_7, and is:

AO_2O_5	Sb_2O_5	CaO	Mno	MgO
53.23	6.54	20.21	10.82	9.20

Gonnard[4] mentions the rare mineral *torbernite* as occurring in quartz veins cutting granite in the neighborhood of Charbonnières les Varennes, Puy-de-Dôme, France. Here are found also fine pseudomorphs of quartz after calcite, the formation of which is explained as having taken place in three stages. 1), by the coating of the calcite crystals by silica; 2), by solution of the calcite, and 3), the filling of the molds left with silicious material mixed with a little clay. Druses of smoky quartz crystals found in the same veins are thought to owe their color to bituminous matter which floated on the surface of the siliceous waters that yielded the quartz and colored those last formed (the druse crystals).

[1]Bull d. l. Soc. Franç. d. Min. 1888. XI. p. 150.
[2]Ib. XI. p. 26.
[3]Neues Jahrb. f. Min., etc. 1889. I. p. 48.
[4]Bul. d. l. Soc. Franç. d. Min. 1888. xi. p. 265.

Rare Minerals.—The interesting zeolite *beaumontite* which has heretofore been known only at Baltimore has lately been discovered by Schmidt[1] in the vacuoles of a pitchstone from Sweden (Mien See.) The mineral has the same habit as the Baltimore crystals. Its double refraction is weak and its optical angle large. The plane of its optical axes is normal to ∞ P∞ and parallel to the edge which this plane makes with oP. Schmidt can see no reason for regarding the mineral as anything more than a variety of heulandite.—Mr. Hanks[2] has given us an account of the occurrence of the rare mineral *Hanksite* from the vicinity of Borax Lake, San Bernardino Co., Cal. The best crystals have been obtained from a stratum of clay and sand underlying a two foot thick surface-layer of salt and thenardite, and from a second stratum of the same materials at seventy feet below the surface. These crystals are bounded by the planes oP, ∞ P, P, and 2P. When the basal plane is largely developed the crystals become hexagonal plates or columns. They vary in size from half an inch or less to three inches in diameter. Hanksite is known to occur also in the borax fields of Death Valley, Inyo Co., Cal., and at several localities in Nevada.—Recent investigations on the *bertrandite* from a pegmatite vein at Pisek, Bohemia, yield Scharizer[3] results differing slightly from those of Bertrand and Des Cloizeaux, who thought the mineral orthorhombic. Scharizer's measurements show it to be monoclinic with B=90° 28′ 34″ and $a : b : c = 1.7793 : 1 : 1.07505$.

NEW BOOKS.—In the "FIRST REPORT OF PROGRESS OF THE GEOLOGICAL AND MINERALOGICAL SURVEY OF TEXAS,"[4] State Geologist Dumble gives a resumè of the rocks and minerals of economic importance existing within the boundaries of the State. Natural gas, petroleum, salt and coal are known to occur in large quantity within the boundaries of Texas, but the limits of the formations containing them have not yet been carefully mapped.—"A COURSE OF MINERALOGY FOR YOUNG PEOPLE,"[5] is a little pamphlet of sixteen pages which accompanies a collection of twenty-five common minerals. It is intended to aid young people in the determination of the most common minerals by teaching them to observe for themselves their most prominent characteristics. The

[1] Zeits. f. Kryst. xv. p. 573.
[2] Amer. Jour. Sci. 1889. Jan. p. 63.
[3] Zeits. f. Kryst. xiv. p. 17.
[4] Austin. State Printing Office. 1889.
[5] By G. Guttenberg, Erie, Pa.

book and the collection comprise the first portion of a course in mineralogy which has been arranged for the use of the Agassiz associations throughout the country. The price of the pamphlet and the twenty-five minerals which it describes is one dollar.—The principal formal and optical characteristics of the more important rock-forming minerals have been arranged by Rosenbusch[1] in sets of tables covering about twenty-five pages. The tables are of great convenience to students who are far enough advanced in the study of petrography to understand the significance of the terms used in them.

BOTANY.[2]

NOTES ON NEBRASKA LICHENS.—Our knowledge of the Lichen Flora of Nebraska is as yet very meager being confined principally to the work of Hayden and Hall during the Government Geological Surveys. Our knowledge, such as it is however, shows that our Lichen Flora has many interesting as well as instructive characteristics. There is a general dearth of the large eastern forms throughout the greater part of the state. There are, however, along the Missouri river and its tributaries, many forms that are found in the eastern states. The Flora of this region serves as a connecting link between the timber forms of the East and the prairie forms of the West. The prairie region has an abundance of earth forms such as Endocarpon, and many Buellias and Biatoras.

Many semi-mountain and mountain forms occur in the western and northwestern parts of the state. Beginning with the eastern border of the state and going west a gradual transition from timber forms to earth forms, is observable; and from these to the forms usually found in higher altitudes as Umbilicaria, Omphalaria, and similar forms.—*T. A. Williams.*

AS TO THE CITATION OF AUTHORITIES.—That the effects of individual eccentricity when given room for free development are always striking, is well shown by the diversity of methods used by botanists in giving authorities for scientific names. In the good old days when but one name, that of the author of the combination, was cited, there was, at least, uniformity and hence some certainty. But the later method

[1] Hülfstabellen zur Mikroskopischen Mineralbestimmung in Gesteinen. Stuttgart, 1888.

[2] This department edited by Dr. C. E. Bessey, Lincoln, Neb.

of citing the author of the specific name and especially the introduction of the parenthesis has resulted in a confusion which is certainly "enough to throw a strong man into blue convulsions." The advantage of the old method is its simplicity. The common objection to it is that it does not give any credit to the author of the specific name. But credit and glory are not the objects in citing authorities; surely it is not the only office of the parenthesis to serve as a sarcophagus in preserving the names of botanists who might otherwise be forgotten. The true purpose is accuracy in determining the species meant. Plants are continually being described under names already occupied, and unless the name of the author is given it is impossible to know what species is meant. Now if one of two plants bearing the same name is put in another genus how, unless the authority is cited, is one to know whether it is a new species or one of the original two, and if so which? On this account it is a great convenience to have the name of the author of the specific name given also. There are several ways of doing this. Some cite the author of the specific name even after the genus has been changed, as if he were the author of the combination, *e. g.* "Hypoxylon colliculosum Schw"—Rav. Fung. Am. No. 742. (for H. colliculosum (Schw.) Nits.) No worse method could be thought of. According to this Sphæria colliculosa Schw and Hypoxylon colliculosum Schw" are evidently two distinct things and some investigation is of course necessary to establish their unity. Schweinitz did not make the combination Hypoxylon colliculosum, and to cite him for it is confusing and absurd. A slightly better method is to give the name of the author of the specific name in a parenthesis omiting that of the author of the combination, *e. g.* "Puccinia phragmitis (Schum.) Winter Pilze 179. This should be P. phragmitis (Schum.) Körnicke. But many, misled by the omission of a name after the parenthesis, have written P. phragmitis (Schum.) Wint., and then P. phragmitis Wint. while on the other hand we find P. phragmitis Körn. In a large genus of intricate synonymy like Puccinia how is one without investigation to know that all these are the same? Another very peculiar method has recently broken out which it is to be hoped will not get abroad; that is, to put the name of the author of the combination in a parenthesis after that of the author of the specific name thus: "Hicoria alba L. (Britt.). Bull. of Washb. Coll. Vol. II, No. 9. This of course if it gains any foothold will give rise to all manner of false citations.

There are only two methods which can be used without making endless trouble and confusion. If but one authority is to be cited, give the author of the combination. Consider accuracy and convenience rather than glory and justice so-

called. If two are to be given, place the name of the author of the specific name in a parenthesis, and that of the author of the combination following, and outside. If, in this case, it seem strange to cite a botanist as an authority for a name he did not know, still it is in many cases the best way. For example, in the case of Lactarius plumbeus Fr. ; if this is written L. plumbeus (Bull.) Fr., one knows that it is Agaricus plumbeus Bull. not A. plumbeus Schaeff, nor Mycena plumbea Fr. Again, Uropyxis petalostemonis De Ton. scarcely seems familiar. But any one can recognize in U. petalostemonis (Farl.) D. Ton., Puccinia petalostemonis Farlow. It may also be objected to this method, that in many cases it merely perpetuates worn out synonymy. But it is the only one which causes no confusion and indicates exactly the species meant. —*Roscoe Pound.*

A Question Regarding the Application of the Law of Priority.—The strict application of the law of priority to botanical nomenclature, raises several interesting questions. One of them is whether a specific name of the same etymology and meaning with its generic name should be retained. There seems no good reason why it should not, as long as they are not identical. Indeed botanists are doing this in the names of many Phanerogams, *e. g.* Echinocystis echinata (Muhl) and Larix laricina (D. R.). The author of these combinations gives Specularia speculum D. C., as a precedent, and Arctostaphylos uva ursi (L.) is almost another. Among the Fungi there is Fomes fomentarius. There are two Fungi which offer excellent opportunities for doing the same, namely ; Ramularia didyma Ung. and Cylindrium septatum Bon. Saccardo gives these as Didymaria ungeri corda and Septocylindrium bonordenii Sacc. But strictly according to the law of priority they should be Didymaria didyma (Ung.) and Septocylindrium septatum (Bon.) However strange these combinations appear, it would seem better as the great majority of specific names are arbitrary and without particular application, to apply the law of priority uniformly, than to make an exception for so slight a cause.—*Roscoe Pound.*

Of Generic and Specific Names too Nearly Alike. —Saccardo (in a note in Syl. Fung. V. p. 474) in commenting upon Winter's change of Cercospora pulvinulata Sacc. & Wint. to C. missouriensis Wint. on account of C. pulvinulus C. & E. reproaches him with admitting Nitzchia and Nitschkia. Saccardo changes the latter to Cœlosphæria on account of

its similarity to the former—a genus of Algæ. This led me to investigate some of the names which Saccardo himself admits. He allows without hesitation Libertella Desm. and Libertiella Speg and Roum ; Licea Schrad., and Lisea Sacc. ; Dichaena Fr. and Dichlaena D. and M. : Pleospora Rabh. and Phleospora Wallr. ; Entoloma Fr. and Entyloma D. B. ; Riessia Fres. and Reessia Fisch. and Eriosphaera Reich. and Eriosphæria Sacc. Whether or not these are too nearly alike depends upon the taste and pronunciation of those who use them. To one using the English pronunciation, Licea and Lisea are indistinguishable. Besides these he admits many which are very much alike, but more defensible, as Arthrobotryum and Arthrobotrys, Urospora and Urosporium. He retains Antennaria Lk. in spite of Antennaria Gærtn., and even gives under the genus Marasmius the sections Collybia and Mycena, although there are the genera Collybia and Mycena in the same family.

As regards specific names : he necessarily admits many which are very similar as pulvinula and pulvinulata, flavus and flavidus, etc. In a large genus, new specific names are rather hard to get and one ought not to be too sensitive. But are not the following too nearly alike : Puccinia penstemonum, Lev. and P. pentstemonis Pk ; P. schileana Speg. and P. scheliana Thuem; P. sclerotoides Mont. and P. sclerotioidea Cooke ? The following in Vols. III. and IV. are certainly indefensible : Phoma pini C. and Hark. and P. pini Sacc.; Phyllosticta viticola Thuem and P. viticola Sacc. and Speg. Zygodesmus ochraceus Corda and Z. ochraceus Sacc., Cladotrichum fuscum Poeuss and C. fuscum (Grev) Sacc.; Cercospora fumosa Pewz. and C. fumosa Speg. These and some others in the two volumes mentioned have been corrected, but in such out of the way places that very few would notice them. Those in Vol. III. are corrected in a note at the close of the index ; those in Vol IV. in a similar note mixed in with corrections of typographical errors. For this reason I have given them. The following from Vols. V. and VI. have not, as far as I can find, been corrected : Polystictus stereoides Fr., and P. stereoides Berk., Fomes calignosus Ces., and F. calignosus Berk., Clavaria cervina B. & C., and C. cervina Sm., Polystictus cinerescens Schw. and P. cinerescens Lev., Stereum concolor Jungh., and S. concolor Berk., Clavaria coronata Schw. and C. coronata Zipp., Cyphella ravenelii B. & C. and C. ravenelii Sacc. This last he substitutes for C. fulva B. & C. to avoid C. fulva B. and Br. But the worst of all is in the genus Polyporus where there is, No. 303, Polyporus armeniacus Berk. Engl. Flor. V. 147. and also No. 215, P. armeniacus Berk. Hook. Journ. 197.—*Roscoe Pound.*

SOME EXPERIMENT STATION BOTANY.—A dozen or so of the bulletins issued by the Agricultural Experiment Stations contain matter more or less botanical in nature. From these the following notes have been rather summarily made.

In Dakota the growth of planted trees during the two years 1886 and 7 was watched and noted.—In Missouri forty "varieties" of grasses were grown and their deportment noted under certain local conditions.—In Kansas the observations upon grasses and clovers extending through fourteen years have been summarized and recorded in Bulletin No.2.—In Florida, the grasses have been grown and watched in like manner.—In Indiana, Professor J. C. Arthur (in Bulletin 15) describes popularly, but accurately, the structure of the potato tuber. The treatment of the subject is admirable and aside from its horticultural value the paper is of value and interest to botanists.—In Minnesota the Bulletin for July, contained a popular account of the organs of fertilization in plants with especial reference to the artificial pollination of cultivated plants.—The August bulletin of the Iowa station contained an interesting paper on corn tassels and silks, and a popular discussion of grasses and other forage plants. Mr. Crozier's notes upon the wild grasses of Northwestern Iowa are valuable, although some of the English names used by him are misleading and confusing. "Blue Stem" for *Agropyrum glaucum* and "Buffalo Grass" for *Bouteloua oligostachya* ought not to be tolerated.—In Texas, Bulletin 3 is devoted to popular notes on native and introduced grasses and other forage plants.—Bulletin 4, of the Minnesota station, devotes sixteen pages to "Fungi which kill insects," by Otto Lugger. The paper is a well written summary derived from various sources, with observations by Mr. Lugger, and is illustrated by nine cuts two of which are original.—The November bulletin, from the Iowa station, includes a short paper by C. P. Gillette on Chinch-bug Diseases (*Empusa* sp. and *Micrococcus insectorum*) and "Some Injurious Fungi" by Mr. Crozier. The latter are Apple Blight, (*Micrococcus amylovorus* Burrill.) Potato Rot (*Phytophthora infestans* DeBary,) Grape Rot (*Læstadia bidwillii* Sacc) and Ergot, (*Claviceps purpurea* Tul.) Mr. Craig contributes some notes on Promising Grasses of Montana, and Idaho, based upon personal observations made during a hasty trip taken at the suggestion of the Governing Board of the station.—In New Jersey, Mr. Hulst reprints at length from Worthington Smith's account in "Diseases of Field and Garden Crops," of Club-Root (*Plasmodiophora brassicæ* Wor.) Some personal observations are added.—Professor Kellerman makes a preliminary Report on Sorghum Blight (*Bacillus sorghi* Burrill) in the December bulletin

of the Kansas station.—Otto Lugger in the January Bulletin of the Minnesota station, publishes a paper on "Frosted and Rusted Wheat," apparently being for the most part a compilation from various sources.—The Spotting of Peaches and Cucumbers is treated by Professor Arthur in the January Bulletin from the Indiana station. The disease on peaches is caused by *Cladosporium carpophilum* Thuem, and that on Cucumbers by *Cladosporium cucumerinum* E. & A. Figures are given of various stages of the fungi.

BACTERIOLOGY.[1]

THE BACTERIA OF SNOW.[2]—In many countries, during several months, snow forms the natural covering of the earth. Waste materials of all sorts, which collect in houses, etc., in many villages and small cities are thrown out directly upon the earth, and in the winter the snow takes the place of the earth in receiving and absorbing contaminating matters. In the spring, the water from the melting snow makes its way into the earth, carrying with it various impurities, some of which may be pathogenic. Whether any change takes place in them during the long time the snow lies upon the earth or whether they enter the earth unchanged, is a question of much importance.

According to the author of this paper, at the time of his writing, there was little or no literature concerning the bacteriology of snow. A number of investigators too, had worked on ice, but no where could he find any reports of examinations of snow. It remained uncertain whether its long stay on the earth changes the number or the character of the bacteria contained in it.

In the bacteriological examination of snow, it is obviously of first importance to secure it pure and free from accidental impurities, as it is often found, for example, on a large clear expanse. As it was evident that there would probably be a difference between snow which had lain long on the earth and freshly-fallen snow, the author made investigations of both kinds. Of fresh snow, some was caught, while falling, during

[1] This Department is edited by Prof. Wm. T. Sedgwick, of the Mass. Institute of Technology, Boston, Mass., to whom brief communications, books for review, etc., should be sent.

[2] "Ueber den Bakteriengehalt des Schnees," von Th. Janowski. *Centralblatt für Bakteriologie* IV, 547.

a snow storm, in a sterilized tube. The snow so taken was melted in a water bath at 30° C. and .5 C.C. of this melted snow mixed with nutrient-gelatin. From this, plates were prepared in the usual way. Other samples of the same snow were also planted, and an average of these showed pretty well how many bacteria were ordinarily contained in such snow.

To insure as exact results as possible, two samples of snow were always taken from different places, and as free from contaminating matters as possible.

From fresh, falling snow, the following results were obtained:—

Feb, 2, 1888. Average temperature, — 7.2° C.
In the first sample 34 bacteria to 1 c.c. of melted snow.
In the second, 38.
Feb., 21, 1888. Average temperature — 11.1°C
In the first portion, 203.
In the second, 384.
Feb., 28, 1888. Average temperature — 12.2
In the first portion, 140.
In the second, 165.

Although these figures differ widely they nevertheless teach us something of the bacteriology of snow, and do not show wider differences than different examinations of ice, made by Fränkel, Prudden and others. A part of the bacteria found in snow are contained in the vapor when it crystallizes. Another, and the larger part, are filtered from the air by the cottony snow-flakes in falling. Consequently, the number of bacteria in the air must be much diminished, after a snow fall, and a true cleansing of the atmosphere appears to be accomplished, such as takes place during a rain. It is also clear that the cottony or wooly structure of the snow-crystal aids in producing this effect, in no small degree. Large differences sometimes noticed in like portions, might be due to the fact that during a snow storm, the snow may sometimes become mixed with impurities gathered from buildings in the vicinity, etc.

In studying snow which has been lying for some time Janowski took samples from the upper layers of snow which had fallen several days before, and which had since lain exposed to the air. In considering the results, it is important to know the range of temperature to which the snow was exposed. This was learned from the official weather reports at Kiew, where his investigations were made.

By means of a sterilized plate of glass he then removed the top of the snow, half a centimetre deep, on top of which the dust from the air rested. From the layer thus uncovered he took his samples and prepared plates as before.

Feb., 11. No snow since the morning before. Temperature during that time ranging from —8° to — 14°.

1st, in 1 c.c. snow water 2.

2nd, " " " " 4.

Feb., 15. No snow for four days. Temperature from —1 to —8°.

1st, portion 8 bacteria.

2nd, " 20 "

Feb., 24. Three days with no snow. Temperature between —11 and —21. Heavy frost.

1st portion 228 bacteria.

These figures seem to indicate that snow lying on the ground some time and exposed to low temperatures, always contains a considerable number of bacteria, and that the low temperature in winter exercises no considerable effect on the bacteria contained.

A number of different kinds of bacteria are contained in snow. Janowski found both those which liquefy gelatine, and those that do not, the former in larger numbers than the latter. He states that one point in particular interested him considerably, namely that he always found in plates from newly fallen snow, as in river water, many colonies which liquefy very rapidly while snow that has been long exposed to extreme cold contains few or none of these. He concludes that this kind, at least, is affected unfavorably by low temperature.—(*M. E. Dodd.*)

THE CHEMICAL ACTION OF CERTAIN BACTERIA.—A paper appeared in the *Journal of the Chemical Society* for August, 1888, by Robert Warington, on "The Chemical Action of some Micro-organisms." Some twenty of the organisms experimented upon were received as pure cultures from Dr. Klein, while six or seven others were isolated by the author himself. The action of these separate species was tested in four respects: 1. The hydrolysis of urea. 2. Action on milk. 3. Capacity for reducing nitrates. 4. Power of producing nitrification.

Warington finds that "the property of effecting the hydrolysis of urea is apparently but rarely met with among micro-organisms; in the present case, out of twenty-four organisms tried, only two could certainly be shown to possess it."

Of the action on milk he says: "The whole of the organisms which fail to gelatinise milk are organisms that do not liquefy gelatin. . . . On the other hand the whole of the organisms which act on milk as ferments liquefy gelatin. . . . We may venture therefore to predict that every liquefy-

ing organism will be found capable of gelatinising the casein of milk."

As regards the reduction of nitrates, Warington states that out of twenty-five organisms seven were entirely without reducing power, one produced a mere trace of nitrite, and one only a very small quantity: the remaining sixteen reduced nitrates in broth, with considerable vigor. With the possible exception of one culture, the reduction to nitrites would appear to have occurred without the production of nitrogen, oxides of nitrogen, or ammonia.

The many investigations of the past few years on the relation of micro-organisms to the process of nitrification have met with little success so far as regards the isolation of a *specific* bacterium of nitrification. Warington's researches in this direction seem to have been little more fruitful than those of his predecessors. His experiments gave mostly negative results, and he concludes his paper with the observation: "An organism which nitrifies as soil nitrifies, has yet to be isolated."—(*E. O. Jordan.*)

BACTERIA, MICROBES, OR MICRO-ORGANISMS?—These terms are being used by various writers sometimes with precision but more often as synonyms. Etymologically "microbe" and "micro-organism" are equivalent terms, meaning simply "a little living thing." But "bacterium" meaning "a staff" is certainly not equivalent to the other two. An arrangement, perhaps as natural and simple as any, is to reserve the term *micro-organisms* for all forms of life which are so small that it is impracticable to study them to any great extent with the naked eye. "Micro-organisms" would then be a usefully indefinite term including many animals as well as plants, *e.g.* the protozoa, rotifers, many crustacea, indeed representatives of nearly every great group of invertebrates, diatoms, desmids, and other micro-algae, besides moulds, yeasts, bacteria, and other micro-fungi. The micro-organisms are only a general and very comprehensive group, divisible, for convenience, into two lesser groups.

These are, 1, *the Microscopical* and 2, *the Bacterial micro-organisms.*

The *Bacterial micro-organisms* are those which are too small to be successfully studied individually and are best investigated in masses by special "cultures." They include the bacteria together with, perhaps, the yeasts and certain moulds.

The *Microscopical micro-organisms* are those which can be successfully studied by the microscope, individually, and without special "cultures." They include all animal micro-or-

ganisms, and all vegetal, excepting those just mentioned under the Bacterial division.

The term *microbe* may be left where it is now oftenest found,—in the newspapers.

The justification for such a classification as the above, is convenience, only. As a matter of fact quantitative ; estimates of the numbers of micro-organisms in any given sample of water, air, ice or snow, are of fundamental importance. At present the bacteria are estimated by cultures, and the other micro-organisms in ways entirely different.[1]

ZOOLOGY.

THE PHALANGES OF BATRACHIA SALIENTIA.—Professor Howes and Mr. Davies read a paper before the Zoological Society of London, Dec. 4, 1888, on the distribution and morphology of the supenumerary phalanges in the Anurous Batrachians. The authors described for the first time the primary mode of development of a supernumerary phalanx. They concluded that the same is in the Anura identical with the interphalangeal syndesmoses, and that the syndemoses and phalanges are derivatives of a common blastema. In its fully differentiated condition the structure in question was shown to be functional in receiving the direct thrust under the weight of the falling body in saltation; all the variations in structure being readily intelligible on that view.

The authors discussed the bearings of the facts upon classification and upon the broader question of the morphology of supernumerary phalanges in general. They showed that the facts of development indicated a probable intercalary origin of the latter from the interarticular syndesmoses; and that the numerical increase of the phalanges in the Cetacea may have been associated with the loss of ungues, somewhat similiarly to the way in which the multiplication of segments of the cartilaginous rays in the paired fins of the Batoidei would appear to have been connected with the disappearance of horny fin-rays.

The authors also showed that the Discoglossidæ alone among the Anura retained for life the undifferentiated syndemoses,

[1] "A new method for the microscopial Examination of water." See *Science*, Feb., 15, 1889.

and that this feature testified more forcibly than anything else to their low affinities. They also described a community of structure between the modified syndemoses in certain Anura and the apparatus of the knee-joint in Mammals, and urged that the facts were such as to necessitate a reconsideration of the morphological value of the latter.

EMBRYOLOGY.[1]

NEW STUDIES OF THE HUMAN EMBRYO.—M. C. Phisalix[2] gives a very complete account of a human embryo of one centimetre (two-fifths of an inch) long. The method of plastic reconstruction from a continuous series of sections is carried out for the entire embryo. The organs which receive special attention and reconstruction are the cranial nerves and nervous system, the disposition of the valves and septa of the cavities of the heart, the origin of the pancreas, and Wolffian bodies. Many points dealt with by His have been more fully elaborated or corrected by Phisalix. The reconstructions seem to have been carried out with great care and accuracy, that representing the relations of the cranial and spinal nerves from the side is very interesting; the same may be said of the reconstructions representing the alimentary canal and its appendages.

The origin of the pancreas from two distinct diverticula will be noted by specialists as a matter of interest The great length relatively of the bronchi at this stage and the acute flexure of the branchial region are very strikingly shown, while the crowding together of the branchial clefts and the diverticula from them which give rise to the thymus gland are admirably shown in their relation to adjacent parts. But as the memoir is hard to understand without the figures which accompany it, the reader is referred to the original for fuller anatomical details.

A curious fact is mentioned by the author in regard to the embryo described by him, viz., its want of perfect symmetry, though believed to be perfectly normal. The left side, especially the region of the cerebral vesicles, was found to be larger

[1]This Department is edited by JOHN A. RYDER, University of Pennsylvania, Philadelphia.

[2]*Etude d'un Embryo humain de* 10 *millimetres.* Arch. de. Zool. Expr. 2 me Ser. vi. 1888. Nos. 2 et 3. pp. 280–350, planches xiii–xviii and figs. A.–F. in text.

than the right. The author asks, is this embryonic asymmetry peculiar to man? And also, does it bear any relation to the functional predominance of the right side over the left in the adult. This memoir is a valuable one, as it supplies a thorough study of one very important stage of the human embryo, and is a very creditable continuation of the work of His and Fol in the same direction.

ON THE DEVELOPMENT AND FIRST TRACES OF THE ANTERIOR ROOTS OF THE SPINAL NERVES IN SELACHIANS.[1]—This last of Prof. Dohrn's studies forms chapter xiv. of the *Studien zur Urgeschichte des Wirbelthierkörpers*; it is most suggestive as is all of his work. The problem of the origin of the anterior or motor roots of the spinal nerves has given rise to a great deal of speculation and discussion. It has been the good fortune of Dohrn to find in embryos of *Mustelus* and *Pristiurus* 3 mill. 5.5 mill. and 10 mill. long, conditions of the development of the anterior or motor roots which are of great importance.

1. The motor roots grow out at the lower angles of the medullary tube before the appearance of the white matter of the cord as conical or more or less produced extensions of the plasma of that tube. At first these roots contain absolutely no nuclei, but are simply homogeneous pseudopod-like processes.

2. Mesodermal cells next approach and sink into these plasmic processes. These probably have something to do with the development of the primitive sheaths of the future nerve fibres.

3. These plasmatic ventral processes from the medullary tube now blend over the extent of their outer surfaces with the still undifferentiated plasma of the adjacent cells of the protovertebræ or somites. Junction of the motor portion of the nervous mechanism with the tissue still to be converted into muscle is thus found to have taken place before even the formation of true nerve fibres or of muscular fibrillæ.

4. The next step in the differentiation of the motor roots is the migration of medullary cells into the above mentioned plasmatic processes from within the walls of the medullary tube. This seems to be conclusively established by the fact that the nuclei of medullary cells were seen in process of division at or within the bases of these processes.

It seems to be thus conclusively established that of the prim-

[1]Ueber die erste Anlage und Entwickelung der motorischen Rückenmarksnerven bei den Selachiern. Mitth. aus d Zool. Stat. zu Neapel. viii. 1888. pp. 441—461. Taf. 22.

itive constitution of motor nerves, neither fibres nor sheaths form a part. Neither are axis cylinders or medullary substance developed. End-organs or terminal branching ramifications of the nerve fibres do not as yet exist, but the capacity for their development is probably inherent in the simple structures and relations above described. The relations described by Dohrn are strongly opposed to the theory of the *ab initio* continuity of nerve and muscle by impalpably fine fibres, and if fully established fatal to Hensen's doctrine. It is needless to add that, while these new results are not wholly in accord with those of Balfour, they will probably serve to complete the true doctrine of the development of the spinal and cranial nerves, the foundations of which were first laid down by that remarkable investigator.

THE MATURATION AND FERTILIZATION OF THE EGG OF PETROMYZON PLANERI.[1] A. A. Böhm in this extended memoir gives a very complete resumè of the work of his predecessors upon the early history of the eggs of the lamprey. The formation of the polar globules is described, and the peculiar manner of union of the segments of the female and male pronuclei are illustrated. It seems that the chromatin substance of the head of the spermatozoon in this process always first breaks up into about four rounded segments or *spermatomerites* as Böhm calls them, which remain for some time lying close together in a straight or curved row.

PHYSIOLOGY.[2]

INHIBITION IN MAMMALIAN HEART.—Professor McWilliam continues[3] his work on cardiac physiology by a study of the phenomena of inhibition in the mammalian heart.[4] The results are given in considerable detail, and can be discussed here very briefly only. The effects of the stimulation of the vagus nerve on the auricles and on the ventricles are in general similar, consisting

[1] *Ueber Reifung und Befruchtung des Eies von Petromyzon planeri*, Arch. f. mik. Anat., xxxii. 4 Hft. 1888. pp. 613—670. Taf. xxiv—xxv.

[2] This department is edited by Dr. Frederic S. Lee, Bryn Mawr College, Bryn Mawr, Pa.

[3] See AMERICAN NATURALIST, Jan. 1889.

[4] *Journal of Physiology*, vol. 9., p. 345.

of a slowing of the rhythm, and a depression of both the contraction force and the conduction power of the muscle; but the functional relation of the vagus to the ventricle is not nearly so close and intimate as to the auricle. The condition and working of the auricular muscle are much more readily and more profoundly altered than are those of the ventricular muscle. Augmentation following the depression, as has been pointed out for the cold-blooded animals, is slight and inconstant, which would seem to be in opposition to Gaskell's idea of the vagus being an anabolic nerve. Section of the vagus causes in addition to the acknowledged acceleration of beat a marked aug mentation in the contraction force of both auricles and ventricles. As has been pointed out in cold-blooded animals, the author finds a local inhibitory area to exist in the mammalian heart, *i. e.*, a limited area, stimulation of which affects the ventricle in exactly the same way as stimulation of the vagus does. In the cat and dog this region overlies the auricular septum on the dorsal aspect of the auricles. The vagus fibres pass through or near it, but it evidently contains structures differing from the vagus in regard to excitability, relations to curari and certain other influences. While normally stimulation of the venous terminations or of the auricles causes an acceleration of beat, under certain abnormal conditions, *e. g.*, in a dying heart, such stimulation results in inhibition, thus indicating under such conditions a reversion to a physiological type normally obtaining in hearts of certain lower vertebrates.

MEETING OF AMERICAN PHYSIOLOGICAL SOCIETY.—The American Physiological Society held its annual meeting in Philadelphia, December 29 and 31, 1888. The laboratories of the Jefferson Medical College and the University of Pennsylvania were inspected, and laboratory methods were informally discussed. The following papers were presented:

1. E. T. Reichert.—"The Excitability of the Different Columns of the Spinal Cord."
2. E. T. Reichert.—"The Rate of Transmission of Nerve Impulses."
3. E. T. Reichert.—"A New Calorimeter."
4. J. W. Warren.—"On Sensory Reinforcements of the Knee-Jerk."
5. H. H. Donaldson.—"On the Changes in Ganglion Cells Due to Stimulation."
6. H. N. Martin.—"The Lethal Temperatures of the Cat's Heart."

7. H. N. Martin.—"The Influence of Light on the CO_2 Excretion of Frogs Deprived of their Cerebral Hemispheres."

The Council for 1888-9 consists of S. W. Mitchell, President; H. N. Martin, Secretary and Treasurer; H. P. Bowditch, J. G. Curtis, H. C. Wood.

Dr. S. Weir Mitchell placed at the disposal of the Society the sum of two hundred dollars to be offered as a prize for researches on the rate of transmission of nerve impulses in man, such researches to be completed at the end of two years.

PHYSIOLOGICAL PRIZE.—In accordance with the offer of Dr. S. Weir Mitchell to the American Physiological Society, the latter Society now formally offers to residents of North America the prize of two hundred dollars for researches bearing on "the rate of transmission of nerve impulses—afferent and efferent—and the duration of reflex and reaction time in the higher animals, especially man; also the conditions—normal and pathological—which alter such rates and times." The work must be done between Jan. 1, 1889 and Oct. 1, 1890. Further information may be obtained of Prof. H. Newell Martin, Baltimore, Maryland: Johns Hopkins University.

PROPOSED INTERNATIONAL CONGRESS OF PHYSIOLOGISTS IN 1889.—In accordance with the circular issued by the English Physiological Society, a meeting was held in Berne, Switzerland, in September, 1888, to consider the advisability of holding, during the present year, an international congress of physiologists. England, France, Germany, Italy and Switzerland were represented. It was decided to hold such a congress at Basle, beginning September 10, 1889. The subjects to be brought before the meetings include Anatomy, Histology, Physics, Chemistry, Experimental Pathology, and Pharmacology, in so far as they bear directly upon Physiology. All communications are to be as little formal and as fully demonstrative and experimental as possible. Professor Miescher and the Department of Education of the City of Basle have cordially approved the project. The committee of the English Physiological Society has been continued with executive powers to organize the Congress, and through a circular requests information concerning probable attendance, titles of intended communications, and details of apparatus required for demonstrations. American physiologists intending to be present may notify Dr. H. P. Bowditch (till July 1st), Harvard Medical School, Boston, Mass; (subsequently) care of Knautt, Nachod & Kühne, Leipzig, Germany.

MICRO-ORGANISMS AND DIGESTION.—The extensive researches which are now being carried on in regard to the relations of bacteria to disease increase our interest in any addition to our knowledge of their connection with the normal activities of the body. Drs. Harris and Tooth, of St. Bartholemew's Hospital, have undertaken a series of experiments to investigate the relations of micro-organisms to digestion, and have published a preliminary communication on the subject.[1] They find it easy to prove that proteids can be digested by pepsin independently of micro-organisms, but have not succeeded in establishing the converse proposition, namely, that micro-organisms can of themselves convert proteids into peptone. In experimenting with trypsin it was found necessary to employ antiseptics in order to make sterile experiments. With mercuric chloride, 1 to 2 per cent. neither peptone nor bacteria appeared, with carbolic acid, 1 to 2 per cent. peptone was abundant but bacteria absent; while iodine interfered neither with the digestion nor the development of bacteria. It was thus proved that the pancreatic ferment, like the gastric, can digest proteids without the aid of micro-organisms.

It was found that the formation of leucin and tyrosin is probably due at least in part to the action of bacteria, and that the formation of indol seems to be entirely dependent upon it. The results of experiments indicate that there are special indol-forming organisms, in the absence of which this substance does not appear.

These conclusions are in substantial accord with views which have been previously entertained, though hitherto they have been accepted without adequate experimental proof.—*M. A. Johnson.*

PSYCHOLOGY.

OBSERVATIONS ON PUTORIUS VISON.—On July 6, 1887, while engaged in geological work on the Cedar River, near Osage, Iowa, my attention was attracted by the peculiar actions of a Mink (*Putorius vison.*) By careful maneuvering, we were enabled to approach to within a short distance of where it was engaged, and there watch its behaviour unobserved. It was an old mother Mink engaged in fishing, for her young.

[1]Journal of Physiology, vol. 9, No. 4.

On the ripples in the center of the stream, where the water was not more than two feet in depth, was a flat Drift Bowlder rising a few inches above the surface. On this rock the mother Mink would take her position, and here watch for small fish to approach, when she would dive into the water, be gone for a moment, and then reappear on the opposite side of the rock, usually with a fish in her mouth, which she would deposit in the center of the stone, and its struggles instantly stop by a quick sharp bite back of the head, which caused immediate death. This process was repeated without intermission, except to stop for an instant to shake the water from her furry coat, until seven fish varying from four to seven inches in length, were deposited on the rock. Then, without stopping to rest, taking one of the fish in her mouth, she plunged into the stream and swam to the shore, climbed the steep bank and ran hastily to her young, in a burrow under an old stump on the bank of the stream, fifty yards away. In a moment she was seen returning, plunged into the stream and swam to the rock, took a second fish in her mouth, entered the river once more, and returned to her young as at first.

This was repeated until all the fish had been carried away. A few moments after having removed the last fish, she returned and began her work once more. This time, however, her labors were without result, so, shifting her position to another rock in the stream, a short distance away, she continued her fishing. But although more than a quarter of an hour was spent in energetic effort, her labors were without avail, and she was this time compelled to return to her young "empty handed."

After waiting for some time, we crossed the stream to examine the burrow, but before going half way, the old Mink was met returning to her fishing ground. From the bank of the stream, where egress from the water was made, to the burrow, fifty yards distant, a well beaten path had been formed by the mother Mink in her daily excursions in quest of food for her young. Not wishing to destroy the burrow (which would have been necessary) the number and condition of the young was not ascertained. How long this Mink had been engaged in fishing before our attention was attracted to her, or how long it would have been continued, had she been undisturbed, it is difficult to say. But it is true that a degree of parental love and affection, (if we may so term it,) was evinced by the mother Mink for her young, in thus so indefatigably laboring, under a scorching July sun, to procure them food, as it is but rarely witnessed.—*C. L. Webster.*

A PECULIAR HABIT OF THE BLACK BASS.—I once observed a singular race between a Black Bass (*Micropterus dolomieu,*) and a soft shelled Turtle (*Aspidonectes spinifer*) and her young. The first noticed was the old Turtle and her young swimming steadily up stream, turning neither to the right hand or to the left, (an unusual occurrence, so far as my observations extend,) and closely followed by a large Black Bass. Both the mother Turtle and her young appeared very much exhausted, and would very often come to the surface for air. The young Turtle, if not disturbed would swim close behind its mother, but the Bass, who was always hovering *over* or following a foot or so in the rear, would often make a lunge for the young one, and apparently bite it, which would cause it to instantly dart *under* its parent, and swim in this position until compelled to come to the surface to breathe. The young one finally became so exhausted and worried by the Bass, that at three different times it was observed to lay hold of the edge of its parent's shell with its mouth, and thus compel her to take it in tow. Not the slightest attention was paid to the young one by its parent.

Several times two or three Red Horse ?(*Moxostoma macrolepidotum,*) attempted to join in the chase, but was each time immediately driven away by the Bass. This performance was watched some time by me, and when the trio was last seen, the "play" was still going on.

We have at other times and in other places, observed this Turtle to be followed by Black Bass. This has also been observed by Dr. Kirtland, (Geological Survey of Ohio, Vol. IV, Zoology and Botany, P. P. 668—669.) Whether the Black Bass is a natural enemy of this species of Turtle, or what its real intention may be in so often following it, we are at present unable to say.—*C. L. Webster.*

ARCHÆOLOGY AND ANTHROPOLOGY.[1]

ANTHROPOMETRY.—Anthropology in its literal sense is Man Science. It deals with the structure, history and development of men. The complexity of man in nature gives birth to many sciences. Some of these are old and some are new.

1. This Department is edited by Thomas Wilson Esq., Smithsonian Institution, Washington, D.C.

By their aggregation or consideration there was born a new science absorbing all the others, forming a harmonious whole, the substance of which is the natural history of man, and the name, Anthropology.

Notice the complexity of the subject and when the science comes to be divided into its distinctive parts, each of which is large enough to form (and in times past some of these have formed) a science in itself and given ample scope to the student for a lifetime.

1. Antiquity of man.
2. Origin of man.
3. Man's place in nature.
4. The races of mankind.
5. Language.
6. Development of Civilization.
7. Anatomy and Physiology of man.
8. Anthropometry or the measurement of human attributes whether physical or mental.
9. Psychology and Biology.

In former times, Archæology, classic, or otherwise, assumed control over much that has now been absorbed in Anthropology. The distinction between the two sciences is at present well defined, and they are now represented by different organizations.

Folklore and numismatics are powerful aids to Anthropology, insomuch that the student of one involuntarily becomes interested in the others. I predict their final absorbtion by the larger and more comprehensive science.

Numbers 1, 2, 3 and 8 in the foregoing list are new sciences. Their names may not be new, but they have, within the past few years, outgrown their former surroundings—burst their shell, so to speak, and now have assumed a position as part of the great science of Anthropology. The novelty of the antiquity and origin of man will always render this study attractive. They will always find their students and devotees. They deal with, that which to us are the great mysteries of the universe; the Whence, the How, and possibly the Whither, of the Human Species.

But number 8 is in danger of neglect at the hands of scientists. It is not attractive. It requires the utmost precision and care. Its results must be recorded, with all their errors. These may be detected in future investigations, and thus return to torment their originator. The work consists largely of dreary wastes of figures carried out to fractions of thousands, registered in a (to us) foreign system—the metric; and what-

ever of interest it may have, that of comparison, either with its own race or with others, does not commence until the future. So it has come to be neglected; but its importance to a study of Anthropology, which shall be at once scientific and valuable, cannot be overestimated. To the doubter of this proposition I propound the following question: How can you determine the different races of mankind except you consider the difference of size, color, form and capacity. And how can this be done without Anthropometry?

The number of divisions into which it has been proposed, at different times, and by different scientists, to separate mankind has ranged from two to sixty. The five great divisions which we were taught as children have been broken up and the later scientists have proposed but three, to which they have given Greek names signifying the particular attributes assigned to each group, instead of the geographical terms formerly employed.

Leucochroi—represented by the Europeans.

Mesochroi—by the Mongolian and American Indian.

Melanochroi (Huxley) or Æthochroi (Dallas)—by the Negro and Australian.

The basis on which this classification has been made is as follows:

1. Statue and comparative height of different parts of the body.
2. Color of skin.
3. Color of hair and eyes.
4. Index, Cephalic.
5. Index, nasal.
6. Cross section of hair.
7. Shape of nose, and in certain cases (to be determined after death), of the pelvis.

From these facts given in figures with the necessary precision, aided by a study of his language, the scientist determines to what division of mankind the individual who is under examination belongs. But I ask how can these facts be gathered except by use of Anthropometry?

This new science of Anthropometry has grown so that what was before unthought of, and perhaps supposed to be unattainable, is now within the commonest demands. The time was when the stature and weight of the human body, the diameter and cubic capacity of the human skull, and the weight of the brain, were about all expected from Anthropometry. But an extended consideration shows that there is little in the Science

of Ethnology, in the study of physical difference between the races of mankind or the individuals thereof, which Anthropometry may not aid in clearing or defining.

Think of the physical differences in the various races of mankind in the present day—take the Western Hemisphere, and beginning at the north, compare the physical differences susceptible of accurate measurement between the Eskimos, Aleuts, Innuits, the North American Indian, the Aztec, the Peruvian, the Patagonian. A moment's consideration will carry conviction that accurate measurement would go far in establishing the dividing line between these races. As to the like benefit among our present Indians, in deciding between different tribes, I offer no opinion, but in obtaining by Anthropometry their status as a race, for comparison with other races, and so fixing their relative position as an Ethnologic group, I have no doubt as to the benefit, and that the work if done would receive the approval of the scientific world. Especially is this true since the combination of the American Indian in the same grand division with the Mongolian. I know of no method, except by Anthropometry, that the comparison between these two peoples can be made with precision; or by which they can with certainty be assigned to the same grand division. This comparison cannot be made by the measurement of a few isolated cases in either continent. The measurement must be of groups of individuals sufficiently large and numerous to establish the peculiarities of the entire people.

This application of Anthropometry to the American Indian falls naturally to the scientist of the United States. None other can do it, and our national pride should say that none other be permitted to do it. If this is a proper work, and worth the doing, it should be done by us. We should here apply the Monroe doctrine of politics. If not done, it should not be because it was neglected, or forgotten; but because we decide it not to be worth the labor and expense, and in this we must justify ourselves in the eyes of the world.

I venture with diffidence the suggestion that the present tried corps of Ethnologic explorers among our Indians might add to their present field duties that of Anthropometry. The corps is already organized and the labor, trouble or expense would be but slight compared with what it would be if a new corps had to be organized. The expense would only be for instruments and tables. The men could receive instructions in the needed manipulations from competent professors before starting. With small practice they could soon master the art,

and learn to measure the human body with celerity and precision, and to record the results with certainty. Of course, the collating these results would be done after their return home by others. The proper professors would afterwards determine the conclusion established by this aggregation of facts.

So important has this science of Anthropometry been considered in Europe that one of the most studious, learned and enthusiastic professors of Anthropology in the world—he who probably stood nearest its head—Paul Broca, devoted himself principally to the study and practice of Anthropometry; he developed the system which bears his name, and his fame stands principally upon his services in this branch. The Societè d'Anthropologie at Paris endorsed his system, published his instructions as its own, and now the world has almost entirely adopted it as the basis of Anthropometry. The necessity of uniformity is so apparent that each country, one after the other, has finally adopted the metric system of measurements, England, I believe the last.

This Societè established, many years ago, a permanent course of lectures upon this subject; one each week during the scholastic year. Broca was the lecturer during his lifetime. This course is still continued and is now in the hands of Broca's successor, Dr. Manouvrier. Anthropometry is thus assigned a place equal in dignity with any other of the branches of the science.

Dr. Paul Topinard is now devoting himself to a work with a duration of many years, of making a chart of all France according to the color of the hair and eyes of the inhabitants. Mr. Francis Galton of London, has been engaged for years upon the work of "Heriditary Stature." He established an Anthropometric Laboratory at the Health Exhibition in London, 1883, where each individual could be measured, weighed and tested in all his parts, the record being furnished him and a duplicate being kept for scientific use, all for 3d. 10,000 people were measured. This system has been continued during subsequent exhibitions —the Fisheries, Colonies, Inventories, &c., and the South Kensington Museum has adopted it permanently. Mr. Galton reports that demands have been made from many places throughout the world for lots of machinery. I listened with much satisfaction to his address on this subject as President of the Anthropological Section of the British Association for the Advancement of Science at Aberdeen in 1885. He then stated the problem which he sought to elucidate; given a group of men, or a single man of any certain and known

stature, and ignoring every other fact, what may be the probable average height of the brothers, sons, nephews and grandchildren respectively, and what proportion of these will probably range between any two specified heights? He found the average height of man in Great Britain, at what he calls the "level of mediocrity" to be 5 feet 8¼ inches. He was able to transmute female to male heights by multiplying by 1.08, or as he says, to state it roughly, add one inch to each foot He established the ratio of height between brothers, between father and son, uncles and nephews, between grandfathers and grandchildren, and calculated the probability for the future. He proved that with all the certainty of divergence in height in individual cases, there was a law which tended to bring the whole people towards their mean level—that the progeny of tall men grow shorter and that of short men taller. And he adds the important fact derived from his study of "Hereditary Genius," that the peculiarities of mankind, say of Genius, follow the same rule. This rule seems reasonable and wise, otherwise while the children of the good people would become "very, very good," yet those of the evil people would become even worse than "horrid," and as the evil are numerical by greater, the world, but for this rule, would soon be given over entirely to evil.

The Societè d'Anthropologie at Paris has issued a full set of instructions adapted to nearly all parts of the world.

General instructions are printed with particular instructions for France, for Australia, Algeria, Peru, Senegal, Mexico, Chili, Sicily, the Red Sea, Cambodia, Central Asia, Maylasia, Madagascar, each separate, but together forming a volume of not less than a thousand pages. Travelers to any of these countries are recommended to provide themselves with these instructions and the necessary instruments, and take observations to be reported back to the Societé. The same general course has been pursued by the principal societies in Europe. I will not attempt to give even a list of the reports made in accordance with these recommendations, such would be so incomplete that it would mislead rather than inform the reader. But it may be summarized by saying that about all we know *with certainty in figures* of the physical characteristics of the various peoples of the world we know from these sources.

I give a sample of the information thus received, a resumé of the report made by Surgeon H. B. Guppy of his visit to the Solomon Islands. He operated upon 72 natives and gives the tables of measurements in every part of the body. His resumé

of the physical characteristics of the average Solomon Islander is as follows: (*Anthrop. Institute*, Vol. XV, p. 281.) "Such a man would have a well proportioned physique, a good carriage and well-rounded limbs. His height would be about 5 feet, 4 inches; his chest girth between 34 and 35 inches and his weight between 125 and 130 pounds. The color of his skin would be a deep brown, corresponding with number 35 of the color-types of M. Broca. * * * The form of his skull would be Mesocephalic. The proportion of the length of the span of the extended arms to the height of the body, taking the latter as 100. would be represented by the index 106.7. The length of the upper limb would be exactly the one-third the height of the body, and the tip of his middle finger would reach down to a point about 3½ inches above the patella. The length of the lower limb would be slightly under one-half 49-100 of the height of the body, and the relations of the lengths of the upper and lower limbs to each other, would be represented by the intermembral index 68.

I grant at once that there are other branches of Anthropology in the United States which have pressing needs for study. The Indian is said to be in progress of extinction like the buffalo, and unless he can be studied soon, in his language, art and industry, it will be too late. This argument for immediate action is all powerful, and should move the United States to all possible exertion. But I submit that it applies with equal force to Anthropometry. If not now, or soon, measured in their groups of tribes, it will be too late. Extinction or mixture of blood between different tribes or with whites would be equally fatal to Anthropometry.

Some of those who have studied the subject most, believe in an identity of race between the North American Indian and the mound-builders of prehistoric times. Anthropometry would be a powerful assistant in proving the fact.

I should much like to see Anthropometry practised upon our native tribes, whether Eskimo, Innuit or Indian, now while we have such splendid opportunities, by means of numerous examples and continued tests so extended and applied to groups of sufficient numbers, as that the physical peculiarities and attributes of each race or tribe might be established upon a scientific basis with mathematical accuracy, and which would be so complete as to be accepted by all the world. For this great subject the United States possesses peculiar facilities.

These would furnish means of comparison between them and all other tribes, races and peoples, whether modern,

ancient or prehistoric. I have wondered often that this most feasible and certain evidence has never been sought by the believer in identity of the North American Indian with the lost tribes of Israel.

The prehistoric race of men in Europe and America belonging to the paleolithic age—the river drift man and the cave dweller—were of much greater antiquity that the mound-builders of the United States, and the savants of Europe seem now to be of the mind that he passed, whether by land or sea is immaterial, to America, and that the Western Hemisphere is peopled from this stock. They think they can trace similarities of implement, art and industry in the present race of Eskimos. How much it would add to the solution of the question to have the physical status of each and all these tribes settled by Anthropometry.

The scientific value of anthropometry is for comparison between different individuals, or tribes, or races of people. In order to accomplish this comparison the measurement must be accurate and done by the same system among all nations. If different systems be employed, the comparison cannot be made with certainty. The tendency of the American mind to invent new systems should be here repressed and we should adopt as universal the metric system of measurement.

ANCIENT MOUNDS AT FLOYD, IOWA.—On the west side of the Cedar River, one half mile east from Floyd, Iowa, are located a group of three ancient mounds. These mounds, instead of being located on the highest eminence in the region, as is most usually the case, are arranged in a slightly curved line, on a high but level space, fifty feet above, and two hundred and twenty yards back from the stream, and midway between two points (from fifty to sixty rods from each) which face the river, and rise from twenty-five to fifty feet above this level space. The ground, between the mounds and the Cedar, has a rather gently sloping surface. At this point the stream makes a bend to the east, and the mounds thus occupy a position on the south side. The north side of the stream is occupied by a steep, and somewhat broken, wooded bank, which affords a limited though beautiful bit of scenery to this place.

This area, as well as the surface of the mounds themselves, was originally possessed by a heavy growth of timber, but which was cleared away more than twenty years ago and the soil kept under the plow ever since. These mounds are low and circular, and twenty feet distant from each other. The

east, or largest mound, is thirty feet in diameter, and was originally two feet high (so reported by Mr. Sharkey, who first cleared, and still owns the tract) although owing to degradation by the plow now rises only one and one half feet above the surface of the ground surrounding the mound. The two remaining mounds are smaller and lower than the first one. The third mound—there may be some slight doubt expressed regarding its origin, for the reason that in the south portion of it there is imbedded a drift bowlder, weighing some seven or eight hundred pounds. This, however, may have been placed here by human hands in the long ago, or the mound may have been an intrusion upon the stone. A partial exploration of the two smaller mounds was made, but without discovering anything.

In making a thorough exploration of the larger mound, however, the remains of five human bodies were found, the bones, even those of the fingers, toes, etc., being, for the most part, in a good state of preservation. First, a saucer or bowl-shaped excavation had been made, extending down three and three-fourths feet below the surface of the ground around the mound, and the bottom of this macadamized with gravel and fragments of limestone. In the centre of this floor, five bodies were placed in a sitting posture, with the feet drawn under them, and apparently facing the north. First above the bodies was a thin layer of earth; next above this was nine inches of earth and ashes, among which was found two or three small pieces of fine-grained charcoal. Nearly all the remaining four feet of earth had been changed to a red color by the long continued action of fire.

All the material of the mound, above and around the bodies, had been made so hard that it was with great difficulty that an excavation could be made even with the best of tools. The soil around the bodies had been deeply stained by the decomposition of the flesh. The first (west) body was that of an averaged sized woman in middle life. Six inches to the east of this was the skeleton of a babe. To the north, and in close proximity to the babe, were the remains of a large, aged, individual, apparently that of a man. To the east and south of the babe were the bodies of two young, though adult persons. The bones of the woman, in their detail of structure, indicated a person of low grade, the evidence of unusual muscular development being strongly marked. The skull of this personage was a wonder to behold, it equaling, if not rivaling in some respects, in inferiority of grade, the famous "Neanderthal

PLATE VIII.

FIG. 1.

FIG. 2.

Fig. 1. A Lateral View of Skull of Mound Builder. Fig. 2. Front View of the Same. Both much reduced.

Skull." The forehead (if forehead it could be called) is very low, lower and more animal like than in the "Neanderthal" specimen. The two following cuts will illustrate this description.

This skull is quite small for an adult individual. The inner portions of the brow ridges are slightly prominent.

The distance from the lower portion of the nasal bone to the upper margin of the eye cavities is only four centimeters. A slight portion of this bone has, however, apparently been broken away.

The distance between the eye sockets at a point midway between the upper margin of the eye cavities and the lower portion of the nasal bone is two and three-fourths centimeters. Only that portion of the skull figured was found intact, the other portions being too much crushed by the weight of the earth from above to allow of a reconstruction of its parts. One of the jaws, containing well preserved teeth, was found. This was rather strong, but the teeth only moderately so. We were at first inclined to consider the strange form of this skull as due to artificial pressure while living, but a critical examination of it revealed the fact that it was normal, *i.e.*, not having been artificially deformed. The teeth of the babe were very small, and the skull thick, even for an adult person.

The next skeleton was that of a man nearly six feet in height. The crowns of all the teeth had been very much worn down, some of them even down to the bone of the jaw.

As before stated, the remaining bodies were those of young adult persons, the skull of one of which was small for a full-grown individual. No relics of any description were found with the human remains in this mound. This burial appeared to be a very ancient one, the limestone fragments in the floor of the excavation being nearly if not all decomposed.

In other mounds opened[1] on the same stream, at Charles City, six miles below, fragments of the same limestone was not infrequently found, but in no case was decomposition visible, except as a thin outer crust, although the human bones, which were usually more or less abundant, were in no case very well preserved, but on the contrary, often nearly or entirely decomposed. The fine preservation of the remains in the

[1] These mounds are thirty-one in number, an exploration of nearly all of which has been made by the writer and the results embodied in a paper soon to be published. A comparison of the method of burial practiced by the Mound Builders near Floyd, and by those of Johnson County, Iowa, (a description of which has been given by us in a paper on "Ancient Mounds in Johnson County, Iowa," and which has been in the hands of the printer for some time) will be of interest.

mound at Floyd was due to the method of burial. This being evidenced by the fact that over a small portion of one of the bodies the earth had not been so thoroughly packed, and as a consequence the bones were almost entirely decomposed away, while the other portion of the body over which the soil had been very firmly packed was well preserved. Judging from all facts gathered, it seems not improbable to suppose that this represented a family burial.

The question has been raised, "How was it that these five persons were all buried here at the same time, their bodies being still in the flesh?" As we have no reason to suppose that these ancient people possessed any means for preserving, for any length of time, in the flesh, the bodies of their dead; it seems plausible to suppose that these individuals were all swept off at about the same time by some pestilence, or else, upon the death of some dignitary of the tribe or people (perhaps represented by the remains of the old man) the other members of the family were sacrificed, similar to the custom which has prevailed among some ancient tribes or races of historic times.

On the same stream, a short distance below this mound, several other mounds occur which promise to yield interesting results, and which we purpose to explore as opportunity offers. —CLEMENT L. WEBSTER, *Charles City, Iowa.*

MICROSCOPY.[1]

THE EGGS OF PETROMYZON.[2]—1. Artificially fertilized eggs were treated with Flemming's fluid, containing a larger admixture of osmic acid than is prescribed in the original formula.

2. After 30 minutes the eggs were washed in distilled water, passed through 30% and 70% alcohol (3 hours in each), and preserved in 90%.

3. The eggs were cut in paraffine, the sections fixed to the slide with albumen, stained with safranine, and mounted in xylol balsam.

[1] Edited by C. O. Whitman, Director of the Lake Laboratory, Milwaukee.

[2] A. A. Böhm, *Arch. f. Mikr. Anat.*, xxxii. pp. 634-5.

CENTRAL NERVOUS SYSTEM OF LUMBRICUS.[1]—If the earthworm is to be sectioned in toto, it is necessary to remove the sand from the alimentary canal. For this purpose, place the worm in a glass cylinder partly filled with fine bits of wet filter-paper. As the paper is swallowed the sand is expelled, and at the end of about two days the alimentary tract is cleansed.

In the study of the ventral cord, Friedländer employed the following methods:

Place the worm in water, to which a little chloroform has been added, and it soon becomes stupefied in an outstretched condition. Then cut open the body-wall along the median dorsal line, and pin the edges down in a dish covered with paraffine or wax. After removing the alimentary canal, the specimen may be treated with a preservative fluid.

1. *Osmic acid* 1%. After an exposure of about half an hour, the worm is sufficiently stiffened to allow the pins to be removed, and it may then be cut into pieces of any desired length. The pieces are then left twenty-four hours in the same solution, then washed, and passed through the usual grades of alcohol. Preparatory to embedding in paraffine, the pieces are saturated with chloroform or toluol. This method is excellent for the study of the neuroglia-like elements, and is the best for the brain.

2. Preparations treated thirty minutes with osmic acid (1%) are transferred to a dilute solution of pyroligneous acid (1 part to three parts water), which reduces the osmic acid very quickly. This is followed by alcohol as before. The ganglion cells are well preserved.

3. The preparation is first treated with weak alcohol, then with stronger grades. After half an hour in 70% alcohol, it is stiff enough for removing the pins, and for cutting into small pieces. Nerve fibres are somewhat contracted by this method, and are thus more easily distinguished from the surrounding connective tissue.

4. Corrosive sublimate (aqueous sol.) and 50% alcohol in equal parts (thirty minutes) gave good preparations of the nerves and the neural tubes.

For preparations according to No. 3, the best stain is a modified form of Mayer's alcohol carmine, absolute alcohol being substituted for 80%. Sublimate preparations are successfully stained with Grenacher's hæmatoxylin. After half an hour in this staining fluid, the preparations are transferred to acidu-

[1] Benedict Friedländer, *Zeitschr. f. wiss. Zoologie*, XLVII, 1, 1888, p. 48.

lated alcohol (50%, with a little hydrochloric acid) ½ minute, then placed in alcohol containing a few drops of ammonia. Connective tissue and nerves are unstained, while ganglion cells are stained deep blue.

The last two methods of staining may be followed by picric acid, which stains the uncolored elements yellow. The process is as follows:

After the sections have been fixed to the slide with collodion and the paraffine dissolved with turpentine or zylol, the slide is placed in turpentine containing a few drops of a solution of picric acid in absolute alcohol. In a few seconds, nerve-fibres, connective tissue, and muscles are stained yellow. The slide is next to be placed in turpentine containing a few drops of alcohol, to wash away the excess of picric acid, then in pure turpentine or xylol preparatory to mounting in balsam.

ZYLOL DAMMAR.[1]—M. Martinotti advocates the use of dammar dissolved in zylol as a mounting medium, to be preferred to balsam in certain cases. He prepares his solution in the following way:

Forty grams of dammar and forty grains of zylol are mixed together in a stoppered bottle and allowed to stand for three or four days at the ordinary temperature; the solution is then filtered. The filtrate, which will amount to about 70 grams, is then evaporated in a water-bath down to about 45 grams.

The object of this concentration is to obtain a solution of the resin in the smallest quantity of zylol possible, just enough in fact to merely dissolve the resin. This concentrated solution becomes yellow, but retains its limpidity. The next step is to dilute this solution with oil of turpentine, by which means the yellowish color is made to almost disappear.

[1] *Journal Roy. Micr. Soc.*, Feb. 1888, p. 153.

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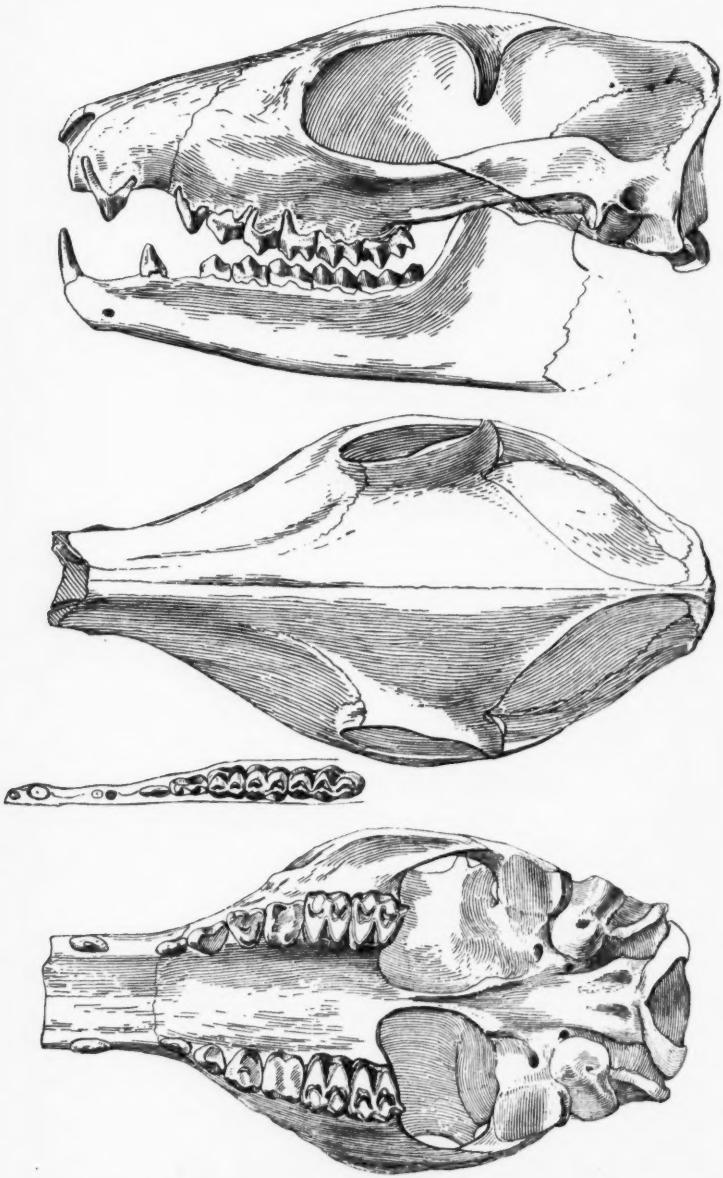
PLATE VI.



Hypertragulus calcaratus Cope. ½. (The pterygoid region injured).